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Capitals, climate change and food security: Building sustainable food systems in northern Canadian Indigenous communities

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by

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Abstract

For many Indigenous communities in Canada's northern boreal forest, the impacts of climate change are directly affecting their ability to access the land they rely on for traditional foods to support their food systems and livelihoods. However, climate change is merely one stressor for communities that have undergone dramatic social, cultural and political changes during the past decades. This research examines case studies in the communities of Dél̨ı̨nę and Kakisa, Northwest Territories (NWT), and identifies community-based solutions to build more sustainable food systems with a focus on food security and climate change. Using participatory action research methods to ensure the process is community-driven and responds to stakeholder needs, each case study identifies vulnerabilities to the respective food systems due to climate change. The Community Capitals Framework – including social, cultural, natural, financial, human, built and political capital – is used to describe and assess the complex food systems in the North. The research illustrates how a community can allocate available capitals to help adapt to the impacts of climate change and identify which capitals are required to build a more sustainable food system. In both communities, addressing issues of food security involved protecting natural capital as well as social and cultural capitals, all of which are important to maintaining traditional foods as the foundation of the food system. The capacity to teach and pass on skills and knowledge to the younger generation, and work together as a community but also with researchers and broader networks, can help promote knowledge sharing. This in turn will enhance resilience in the community in the face of climate change. Building human capital through training and education, and being supported through funding and a network of organizations, was also key to providing

long-term food security to the communities through the growing of food and enhanced monitoring of the land. Issues of place, space and scale drive small differences in the food systems in these communities where access to, and availability of, different capitals shape food systems in different ways. However, having access to political capital, or decision-making authority over food and land resources, emerged as a critical capital that could develop, or spiral up, other capitals and shift conversations about food security towards issues of food sovereignty in the North. This research sheds light on the complex interactions of different capitals of community food systems and highlights the importance of place-based solutions as well as the need for regional cooperation and networks to address food security issues in the North.

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List of Abbreviations

C	Celsius
CSO	Civil Society Organization
CCF	Community Capitals Framework
CBPR	Community-Based Participatory Research
CAS	Complex adaptive system
DFN	Délı̨nę First Nation
DLC	Délı̨nę Land Corporation
DRRC	Délı̨nę Renewable Resources Council
FAO	Food and Agricultural Organization of the United Nations
GNWT	Government of the Northwest Territories
IPCC	Intergovernmental Panel on Climate Change
KTFN	Ka'a'gee Tu First Nation
km	kilometer
NGO	non-governmental organization
NFTI	Northern Farm Training Institute
NWT	Northwest Territories
PAR	Participatory Action Research
POPs	persistent organic pollutants
PCBs	Polychlorinated biphenyls
ROS	rain-on-snow
SRRB	Sahtú Renewable Resources Board
SSI	Sahtú Secretariat Incorporated

SL	Sustainable Livelihoods
SoS	System of Systems
UNESCO	United Nations Educational, Scientific and Cultural Organization
WLU	Wilfrid Laurier University

1 Background and Literature Review

1.1 Introduction

This chapter explores the relevant literature and background that informs the research objectives to be addressed in the following chapters. It begins by discussing issues and concerns with the global food system and how food insecurity and instability in providing adequate food for communities across the globe has led to calls for more sustainable food systems. Issues of food system globalization are intertwined with global social changes and have contributed to the on-going food insecurity crisis in the Canada's North (hereby defined as comprising of the three Northern Territories of Yukon, Northwest Territories, Nunavut as well as Nunavik (northern Quebec) and Nunatsiavut (in Labrador)). These issues are complex and often interconnected and impacts northern communities' access to nutritious and culturally appropriate food. The impacts of climate change will then be presented as factors further compounding issues of food insecurity across the North. This will highlight vulnerabilities and adaptations in community food systems as discussed throughout the literature. The chapter will then shift to viewing food insecurity and climate change adaptation though a systems-based approach to climate change adaptation, discussing resilience, complex adaptive systems and Sustainable Livelihoods literature before proposing a novel, systems of systems approach to the northern food issues. In summary, this review outlines the basis for a more holistic and integrated view of food issues in the North. Research objectives and outline of subsequent chapters are also presented.

1.2 Background and Rationale

The global food system, through innovations such as the Green Revolution, has been a marvel of human ingenuity. Over the past 50 years, technological advances, such as industrialized agriculture, fertilization and pesticide application, have led to a three-fold increase in crop production globally (Food and Agricultural Organization (FAO) of the United Nations 2013). Advances in feeding a growing population have also come at a considerable price. Industrial agriculture has had a profound impact on our local and global environments (Horrigan et al. 2002, Godfrey et al. 2010, Tilman et al. 2011). As well, global markets and rising costs have resulted in the uneven distribution of food throughout the world. As developed countries struggle with an obesity pandemic, others, mostly in the developing world, suffer from food shortages and chronic malnutrition (Swinburn et al. 2011). Access to affordable and nutritious food has become an issue for many. Food security, therefore, has emerged as an issue in regions throughout the world.

Food security is defined by the FAO as "a condition in which all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996). Not meeting these requirements, or being food insecure, is closely linked to poverty. It is widespread throughout developing nations, impacting over 800 million people globally, and is present in certain populations in developed nations, such as Indigenous communities (Cook and Frank 2008, Council of Canadian Academies 2014). Food, as part of this global system, is a commodity that allows countries, regions and individuals to be food secure if they have the financial means to do

so, through purchasing or importing of food. For some countries this has evolved into a land grab with purchasing land in developing countries for food production, typically from food insecure countries (Seo and Rodriguez 2012). Further compounding food insecurity is the rising price of oil, which increases the cost of production and transportation of food. As well, demands for the use of crops for biofuels continue to add to food prices (Clapp and Fuchs 2009, Gilbert 2010, Dauvergne and Neville 2010). It is clear that the global food system is not functioning to the benefit of most people throughout the world and more will be marginalized as the gap between rich and poor continues to grow.

The need to create change in the food system to address food insecurity and meet the needs of a growing population is made yet more complex by the impacts of global climate change. Human-induced climate change has finally gained acceptance in the global dialog as a major threat to the planet and will have severe impacts to livelihoods around the world, in particular those already at risk of, or currently experiencing, food insecurity (Schmidhuber and Tubiello 2007, Food and Agricultural Organization (FAO) of the United Nations 2016). Globally, climate change will impact different regions in different ways. For some, it will have negative consequences for crop yields through decreased water availability and increased frequency of extreme climatic events (heat waves, droughts, floods and other hazards) (IPCC 2014). For example, in Latin America and Africa maize crop production has been projected to decline 10% by the year 2055 (Jones and Thornton 2003, IPCC 2014). These changes will have an adverse impact on food production and prices, increasing food insecurity in affected regions (IPCC 2014, Food and Agricultural Organization (FAO) of the United Nations 2016). Of course, there will be localized opportunities for increased production of food, including warmer temperatures and longer growing seasons in

areas that have limited opportunity to grow food, and opportunities for adaptation (Smit and Skinner 2002, Lobell et al. 2006, Howden et al. 2007). In addition, there are significant local impacts to these regional and global issues that will impact food systems and vulnerable communities. Subsistence farmers, for example, will be forced to change crops to adapt, as moving their farm or buying more land in suitable areas is not possible. This will force local food systems to change. In areas of more complex food systems where other food sources, such as livestock, depend on a feedstocks that can no longer be grown locally, these shifts in production can have significant impacts on both local and regional food systems, likely leading to an increase in costs and further marginalization of subsistence communities and livelihoods (Jones and Thornton 2003, Adger et al. 2014, Altieri and Nicholls 2017).

Even under changing global climate and market conditions the underlying issues are the same: those that can afford food will continue to be food secure as the current food system will adapt, more or less, to climate change through efficiencies, technologies and policies (Smit and Skinner 2002, Howden et al. 2007, Ingram et al. 2008, Kurukulasuriya and Rosenthal 2013). It is the regions and communities that are currently on the margins of the food system, either those living in subsistence-based systems, those closely tied to the land, or those already living in poverty-stricken areas, that will be the most impacted by climate change and food insecurity (Schmidhuber and Tubiello 2007, Power 2008, Costello et al. 2009). Adaptation, therefore, at the community and regional levels will be vital to ensure food security in the face of climate change (Smit and Pilifosova 2001).

Current literature on adaptation to the impacts of climate change often focuses on addressing vulnerabilities, both at regional and local scales, and addressing these through place-based adaptations (Ford and Smit 2004, Adger 2006, Smit and Wandel 2006). There are, however, limitations to vulnerability approaches as they tend to offer short-term responses to shocks or stresses without accounting for future disturbances, and sometimes at the expense of future adaptation (Miller et al. 2010). However, vulnerability can be a step to a more holistic framework for addressing climate change: resilience. With origins in ecology, resilience examines how much stress a system can handle before it fails, changes, or advances to another stable state (which can be either positive or negative) (Holling 1973, Gunderson and Holling 2002). In essence, it examines how a complex socio-ecological system continues to adapt over time and is driven by social connections, governance and functions on multiple scales (Folke et al. 2004, Folke 2006, Berkes and Ross 2013, Ross and Berkes 2014). Building food systems that are resilient to the impacts of climate change and will address the needs of communities in the future should be a priority, but building resilience into existing frameworks will be challenging as, ultimately, global pressures, be they socio-economic or environmental, will force the need for dramatic change in many parts of the world. In these places, where adaptation simply is not enough, or not possible, due to lack of capital, be it financial, social, environmental, political or other, transformation needs to happen (Kates et al. 2012).

What is clear is that more sustainable and equitable alternatives to this global food system must be examined in order to address issues of food insecurity. The immediate need, therefore, is to foster change in the global food system through both the integration of sustainable methods to help mitigate the impacts of climate change and environmental degradation caused by industrial

agriculture (Tilman 1998, Godfrey et al. 2010, Tilman et al. 2011), but also promote both fair and just alternatives and sustainable food systems at regional and community levels to ensure access to food for all (Fresco 2009). The emergence of local and sustainable food systems has been a solution where food is used as a driver of social and environmental change, and ultimately sustainable development, at local levels (Christy et al. 2013, Blay-Palmer et al. 2013b, Hinrichs 2014). These local food movements have also lead to refining the discussion of food security, ensuring the socio-cultural aspects of place are included while empowering communities to define what food means to them. Defining food security should now be done in the context of community food security (CFS), as *"a situation in which all community residents obtain a safe, culturally acceptable, nutritionally adequate diet through a sustainable food system that maximizes community self-reliance and social justice"* (Hamm and Bellows 2003 p. 37). This definition of food security also incorporates the global movement of Via Campesina, which introduced food sovereignty which is where communities define their own food system, and is largely based on the right to food (Patel 2009, 2012). Although known as the peasant movement, the notion of food sovereignty has begun to enrich food systems dialog as the basis for alternative food systems, particularly in marginalized communities, as a tool for community empowerment. The need is, therefore, to establish a broad dialog with communities around the globe who face issues of food insecurity compounded by climate change. The actions that these communities take to address vulnerabilities in their food systems and make them more resilient and sustainable are valuable lessons to other communities around the world. By building case studies, these marginalized communities will be given the opportunities to learn from one another and adopt their own place-based strategies to ensure community food security now and in the uncertain future under global change.

1.3 Food (In)Security in Canada's North

Food insecurity in Canada's North received national and international attention in recent years. A critical report on the state of food security in Canada by the United Nations Special Rapporteur on the Right to Food highlighted the alarming rates of food security in Canada's Indigenous populations (De Schutter 2012). For a developed country such as Canada to have 17% to 69% of households northern communities reporting moderate to high food insecurity, dramatically higher than the national average of 8% (Rosol et al. 2011, Council of Canadian Academies 2014, Tarasuk et al. 2016), highlights the failure, at multiple scales, to ensure the availability, accessibility and adequacy of food. The right to food was guaranteed through Canada's commitments to Universal Declaration of Human Rights and the International Covenant on Economic, Social, and Cultural Rights but the lack of national policy restricts enforcement of these rights (De Schutter 2012). For northern Indigenous communities, the right to food is more complex as issues of remoteness, lack of economic opportunities and infrastructure compound issues of food insecurity (Council of Canadian Academies 2014). The Right to Food is tied to issues of access to land and resource rights as their food systems depend on the health of the ecosystem, and are made more complicated by issues of development, politics and globalization (Blay-Palmer et al. 2014). Numerous issues have shaped, and continue to shape, communities and food systems in the North and change the relationship they have with the land. Social, economic and political issues play a major role in influencing food security and the well-being of these communities (Power 2008, Loring and Gerlach 2009, 2015, Council of Canadian Academies 2014). Addressing issues contributing to food insecurity in northern communities is difficult as many of them are complex with no easy solution – a "wicked" problem that requires a new approach (Petrov et al. 2016).

1.3.1 Place-based food systems

Food systems are defined by place and local circumstances (Marsden 2012, Blay-Palmer et al. 2015). In the Northwest Territories (NWT), the boreal forest is the most widespread ecosystem and is home to 29 communities, including the capital, Yellowknife (Figure 1). As such, the Indigenous peoples of the NWT, which account for approximately 50% total population, but make up the majority of the population in the communities outside of the capital, have relied on the boreal ecosystem to support their way of life. The food system throughout the North is still based upon the Traditional Economy, which includes subsistence harvesting – hunting, fishing and gathering – and functions through social and cultural customs and traditions. The sharing of food, particularly harvested food sources called country food, typifies the social interactions and relationships that are a vital part of the Traditional Economy. This practice is common throughout the NWT and other parts of the country and can be highly organized within communities (Condon et al. 1995, Collings et al. 1998, Chabot 2003, Abele 2009, Collings 2011, Dombrowski et al. 2013b, Skinner et al. 2013). Food systems in Indigenous communities in the NWT have needed to adapt and change over time, mostly to seasonal changes on the land, migration and availability of animals and other local variables. It is a close connection and relationship with the land and understanding of this natural variability that has enabled communities to thrive for so long. Traditional Knowledge, a place-based system of knowledge based on practice, experience and belief regarding the close relationship between humans and the environment (Berkes 1999), is therefore critical to this food system. The passing down of this knowledge through generations, allows for younger generations to access the land and provide food for the community. The concept of place, therefore, is of great significance to Indigenous communities, as the land is crucial to their well-being and way of life (Wilson 2003, Cunsolo-

Willox et al. 2012, also see Tuan 1977; Tuan 1975; Relph 1976). For Indigenous communities in the NWT the close relationship to the land, being on and living off the land, also including elements of self-governance, practicing cultural and spiritual traditions, the social network and support of the community (Bartlett 2005, Parlee et al. 2007) are all essential parts of the food system.

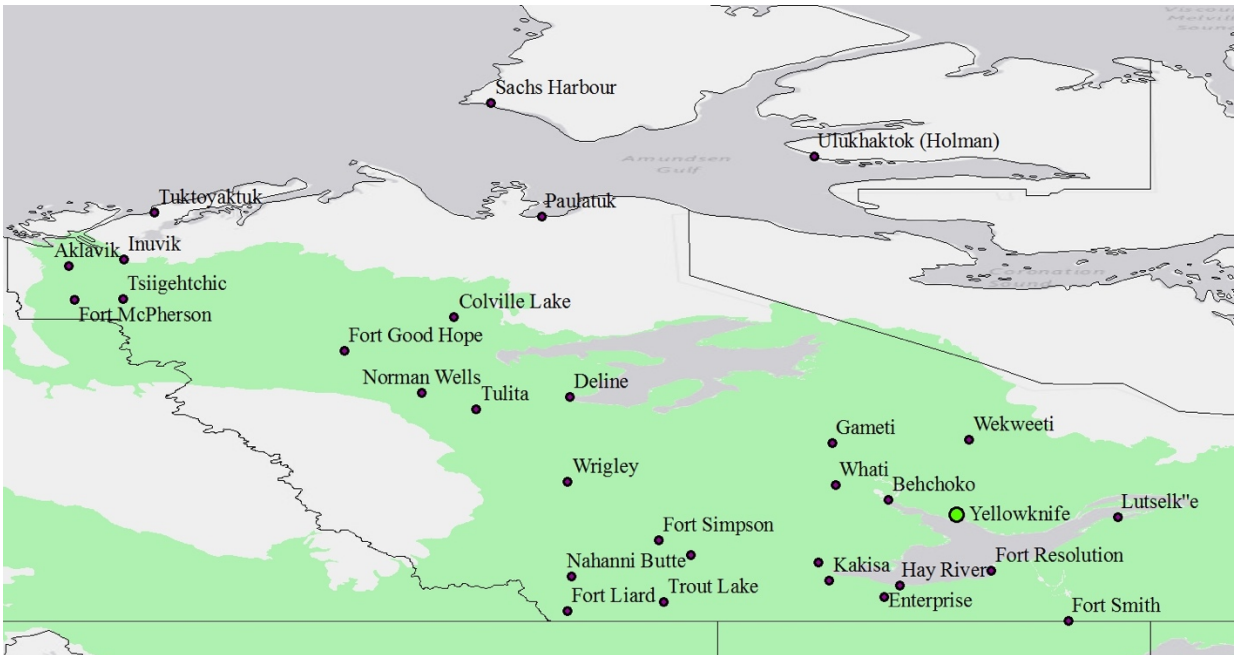

Figure 1. The extent of the boreal forest in the NWT, showing the communities

Indigenous peoples of Canada's North are connected to the land, but this relationship has changed over the past decades. The impacts of colonialization and the transition to settlements through government policies throughout the mid-1900s brought infrastructure and the wage-based economy that introduced jobs for some. Those who could not find work could rely on social assistance and welfare as a source of income or as a supplement to other income from the Traditional Economy. The traditional way of life was altered by the emergence of a formal economic system, one that is the combination of traditional practices and market goods: the

Mixed Economy (Usher et al. 2003). As the attachment to the new settlements increased, due to reliance on jobs or infrastructure, less time was spent on the land and income from other sources led to a decreased dependence on the Traditional Economy. The development of natural resources in the North was therefore needed to support the economy of communities. It was predicted that the development and modernization of the North, and a shift towards the wage economy, would see the traditional economy disappear (Usher 2003). A watershed moment came during the 1970s with the Mackenzie Valley Pipeline Project. The Berger Inquiry was established to consult with communities regarding potential impacts and concerns over the development (Gamble 1978). Communities expressed concerns about environmental impacts, and the fear of loss of culture, as well as the belief that they would not benefit from the development but instead bear the social cost (Usher et al. 1992, Dana et al. 2009). It was recognized in the Inquiry's findings that traditional activities were still the backbone of the native economy, and wage-based employment was seen as a way of providing for and supporting these activities (Stabler 1989). Furthermore, it was suggested that this development would have a significant negative impact on the Dene of the Mackenzie Valley, and that communities were not ready to participate in and therefore benefit from the development. Ultimately, a 10-year moratorium was put in place while outstanding land claims were settled, new programs and institutions established, and more research done to understand the social and cultural relationships that exist in the affected communities (Berger 1977, Usher et al. 1992). Since the Berger Inquiry, the landscape has changed, comprehensive land claims have been settled in the Inuvialuit, Sahtú, and Gwich'in regions of the NWT and in Nunavut granting rights to land (surface and some sub-surface rights), decision-making authority, and funding to Indigenous groups. This has gone a long way to protecting access to natural resources, such as traditional

foods and wildlife, through co-management boards that limit access of non-beneficiaries to local resources (Parlee et al. 2006). For those regions without settled claims (and even for those with settled claims) there can be no, or limited, acknowledgement of ownership of traditional lands by others (Damman et al. 2008). This plays out specifically with respect to subsurface rights and oil and gas development as aboriginal communities still have limited say in these matters. Such development requires infrastructure to support ongoing activities, all of which will have an impact on the landscape. Access roads and right-of-way infrastructure, such as pipelines and seismic lines, contribute to permafrost thaw (Wolfe and Walker 1987, Smith and Riseborough 2010, Williams et al. 2013), alter water drainage across the landscape (Forman and Alexander 1998, Williams et al. 2013), cause forest fragmentation (Drohan et al. 2012, Kiviat 2103) and impact key wildlife species such as caribou (Vors et al. 2007).

Economic development, land rights, management and protection of natural systems are all part of the complex situation that has developed in the North and have direct impacts on food security. The need for wage-based income is now crucial due to the high cost of living in the North, but employment opportunities are still sparse and leave less time to participate in traditional activities. With less time spent on the land harvesting country food, communities become more dependent on store-bought foods. As a consequence, past decades have seen a transition in diets of Indigenous communities in the NWT, consistent with changes across the globe, moving away from traditional food sources to food purchased from stores (Kuhnlein and Receveur 1996, 2007, Drewnowski and Popkin 1997, Popkin 2002, Kuhnlein et al. 2004, Damman et al. 2008). Younger generations in particular prefer store-bought foods over country food (Kuhnlein and Receveur 2007). This change is having a negative impact on the health of the people living in

these communities, as purchased food often provides less nutritional value and more energy in the form of carbohydrates and fat than traditional diets, and has been linked to increases in diet-related health issues such as obesity and diabetes (Receveur et al. 1997, Kuhnlein et al. 2004, Kuhnlein and Receveur 2007, Johnson-Down and Egeland 2010, Egeland et al. 2011, Gagne et al. 2012). The high cost of food and lack of affordable, nutritious options are often cited as major barriers to food security in the North. Nutrition North, a federal program aimed at subsidizing the cost of food for many northern communities, was created to address this issue. But there has been widespread criticism of Nutrition North, namely for not reducing the high cost of food (De Schutter 2012, Galloway 2014). However, the high cost of food is only one barrier. It is becoming increasingly difficult to participate in the Traditional Economy due to the high cost of supplies and equipment needed for harvesting. High cost of fuel, in particular, is often cited as a barrier to obtaining traditional foods and being on the land (Lambden et al. 2006, Loring and Gerlach 2015). Individuals may find themselves in a situation where they cannot afford food either from the land or the store. Of most concern is the fact that some youth are not participating in traditional practices, and therefore often lack the skills needed to survive on the land (Power 2008, Pearce et al. 2009b). This overall decline of harvesters, in the long-term, translates to increased food insecurity and weakness of food sharing networks (Beaumier and Ford 2010, Ford et al. 2010a). To further complicate northern food systems, communities are now dealing with the impacts of climate change which are fundamentally altering the landscape and severely limiting their ability to access the land and support traditional practices.

1.4 Climate Change and its Impact on Northern Food Systems

Climate change is a reality that northern communities must face as it is having profound impacts on natural capital, which includes both the ecosystem and country food sources. Part of northern Canada has seen an increase in temperature of 1.5–2.7°C over the past decades, roughly 4 to 5 times greater than the global average; ecosystem form and function are being dramatically changed in a relatively short period of time (IPCC 2014). Permafrost thaw, degrading sea ice conditions, changing migratory patterns of animals, increased intensity and frequency of wildfire and changes in water availability are impacting the region. These impacts are projected to continue to intensify in the future (Price et al. 2013, IPCC 2014) with direct and often negative implications for the ability of individuals and communities to hunt and gather country foods (Nickels et al. 2006, Ford et al. 2006a, 2008, 2010c, Guyot et al. 2006, Pearce et al. 2009b, Andrachuk and Smit 2012, Wakegijig et al. 2013, Chen et al. 2013, IPCC 2014). These changes have the potential to impact food security in two main areas: access and availability of country food. The next section will focus on how changing climate conditions, permafrost thaw, forest fires and contaminants are emerging issues in food security for northern communities.

1.4.1 Changing Weather

Northern communities have observed unpredictable weather, different snow and ice conditions that have led to hazardous travel conditions, stranded or injured hunters and damaged or broken equipment (Berkes and Jolly 2001, Pearce et al. 2009b). Travel overland takes more time, as unpredictable conditions require greater caution to minimize risk to the harvesters. The high cost of repairing and replacing equipment, such as a skidoo, may be prohibitive to many community

members and can be the difference between being able to be on the land and no longer participating in the traditional activities.

Warmer temperatures impact waterfowl and other migratory birds. As seasonal changes occur, not only in the North but also in the regions from which species migrate, migration timing or routes may be altered to coincide with availability of food. Variations in species arrival or departures, depending on conditions, can make planning for hunting trips difficult and impact harvest success (Walther et al. 2002, Guyot et al. 2006). This warming might also introduce new species into the region, which in some cases may provide alternative food sources to communities (Guyot et al. 2006). However, the introduction of new species can have detrimental impacts on the balance already present in the ecosystem (Walther et al. 2002) with the potential to impact Traditional Knowledge sources regarding country food harvest. Furthermore, new species have the potential to bring diseases or parasites into altered systems and impact the health of wildlife populations that are traditional, culturally important food sources. For example, deer are a new species to the southern part of the NWT. They directly compete with other large herbivores such as moose and caribou and carry winter ticks and their associated pathogens that reduce fitness in moose (Kutz et al. 2009).

Changes in precipitation patterns also have an impact on wildlife. The phenomenon of rain-on-snow (ROS) (Putkonen et al. 2009), where precipitation falls as rain during times where there is snow on the ground, results in denser snow pack and icy conditions (Chen et al. 2013). Caribou, for example, have a harder time accessing lichens under this harder snow layer while their key predator, wolves, are able to move more easily across the crust thereby enhancing risk of predation

(Tyler 2010). ROS events in the Arctic have been blamed for deaths of entire herds of muskoxen (Putkonen et al. 2009). With the likelihood of ROS events increasing due to a warming climate (Chen et al. 2013) this could compromise wildlife availability for communities.

Warmer winter temperatures have an impact on the availability of store-bought food as well. The timing of freeze-up and thaw cycles negatively impacts the operation window of winter roads throughout the NWT (Stephenson et al. 2011). These roads offer remote communities a limited window of opportunity to resupply fuel, food and other resources that cannot be transported in by other means. Winter roads are the lifeline for many communities. But if winter temperatures continue to rise, and snow/ice conditions continue to change, the strength of the ice roads will also decrease making more frequent, lighter loads necessary (Prowse et al. 2009). This will further complicate the logistics of transportation and cost to resupply remote communities and have a dramatic impact on food security. Building permanent roads to service some or all of these remote communities will come at a tremendous cost and is not a viable option.

1.4.2 Permafrost Thaw

Permafrost is a term given to soil, rocks and sediment that remains at or below 0°C for two consecutive years. In the NWT, permafrost extends across the entire land area, although thickness and extent can vary (Figure 2). Warmer temperatures are causing permafrost to thaw, a process that stands to be one of the main challenges facing communities in the North. Permafrost thaw leads to, in many cases, the development of thermokarst landscapes characterized by changes such as ground surface subsidence, active layer slumps, or the transition from forest to a bog/fen-dominated landscape with subsequent changes to ecosystem function (Jorgenson and

Osterkamp 2005, Quinton et al. 2011, Kokelj and Jorgenson 2013, Baltzer et al. 2014). These impacts of permafrost thaw are not uniform across the territory as the severity of change depends on the ice content of the substrate. However, this fundamental change in land cover and ecology leads to issues of food access and availability for communities. Land slumps can degrade water bodies, impacting aquatic ecosystems and fish populations (Jorgenson and Osterkamp 2005, Kokelj and Jorgenson 2013). Large-scale conversion of forested ecosystems to wetlands will decrease caribou habitat through loss of spruce-lichen forests (Joly et al. 2012). Furthermore, changes in topography can make it more difficult for harvesters to access the land and uneven terrain can contribute to safety concerns for land users (Kokelj and Jorgenson 2013, IPCC 2014).

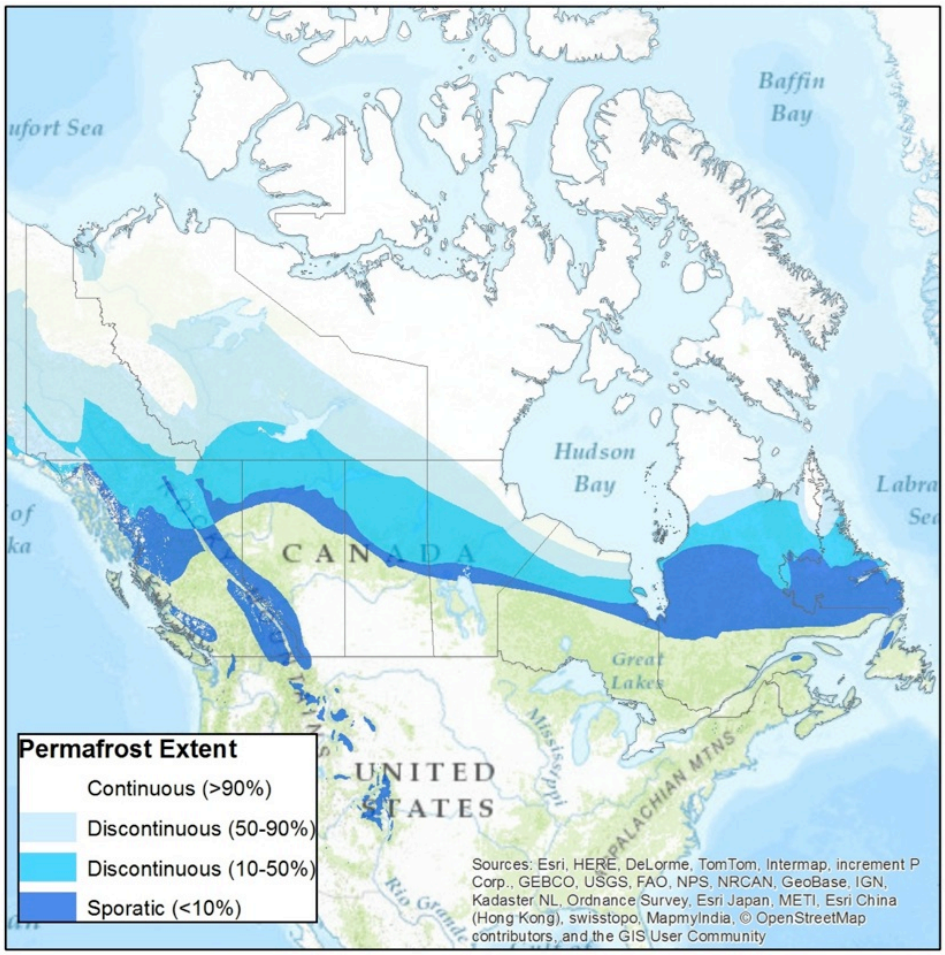

Figure 2. Geographical extent of permafrost in North America (Data: Atlas of Canada).

1.4.3 Forest Fire

Forest fire is part of the natural regeneration cycle of the boreal forest. Climate change is predicted to increase precipitation in the NWT. This increase is, however, masked by the increase in evapotranspiration that is occurring due to higher temperatures (Price et al. 2013). This translates to increased risks of drought conditions in the northern boreal forest and, coupled with increases in storm severity, creates ideal conditions for more intense and severe forest fire seasons. The 2014 fire season was, however, the most intense on record for the NWT, not only due to the amount of land burned, but how it impacted communities. Fires have an impact on wildlife habitat, as large areas can be cleared during a fire. Caribou rely on lichens as their major food source, particularly during the winter months, and, typically, lichens are associated with older spruce forests throughout the boreal as they can take up to 50 years to establish (Rupp et al. 2006). As the boreal forest is predicted to experience more frequent and intense fires in the future, this can be expected to have a negative impact on caribou habitat quality (Joly et al. 2003, Rupp et al. 2006, Robinson et al. 2012). With less land available as caribou avoid burned areas, travel patterns may change as animals search for suitable habitat (Gustine et al. 2014). For communities who rely on caribou as a source of country food, this could result in more time, effort and resources required to hunt this species (Nelson et al. 2008). Other species, such as moose, often return early to fire sites (within 3 years), depending on the severity of burn and presence of food sources (Nelson et al. 2008). This could result in increased habitat for moose and increase in their populations. However, moose compete directly with caribou and high moose numbers may be followed by an increase in predator populations that, with more interactions with caribou, could further threaten caribou populations (Joly et al. 2012, Robinson et al. 2012).

1.4.4 Contaminants

Contamination of country food species, particularly fish, is a major concern for communities in the North. As pollutants, mainly produced at lower latitude, are transported northward and deposited through various processes, they enter marine or terrestrial food webs, through bioaccumulation. Communities are at risk from exposure to these contaminants as they occupy the top of the food chain. Mercury, arsenic, lead and cadmium are of most concern and have been recorded in both food species and individuals; however, radionuclides, polychlorinated biphenyls (PCBs) and other persistent organic pollutants (POPs) are also of concern (Kuhnlein and Chan 2000, Donaldson et al. 2010). Detectable levels of mercury have been recorded in various fish species from lakes around the NWT (Lockhart et al. 2005); in communities that rely on fish as a staple of their diet, elevated levels of mercury have been found in fish (Berti et al. 1998) leading to health advisories. Elevated levels of mercury have also been observed in caribou, whose main food source, lichens, contain more mercury than other vegetation (Gamberg et al. 2015).

As climate changes, there is an increased risk to communities as pathways, both biological (species and processes) and physical (transportation of contaminants), will be intensified (Kraemer et al. 2005, Stern et al. 2012). Although restrictions on applications of these chemicals in other regions of the globe may help lower future risks of contamination, there is a concern that contaminants locked away in frozen sediment could be made biologically available due to climate change (Loseto et al. 2004, Stern et al. 2012). Permafrost thaw can be responsible for releasing stored mercury into the system (Klaminder et al. 2008). The issues of contamination

are critical to the food security dialog in the North. As country food sources are being impacted by climate change, foods that communities rely on in times of need, such as fish, cannot always be seen as a safe alternative. The impacts of climate change are adding complexity to an already complicated mix of issues.

1.5 Vulnerability and Adaptation

Climate change will make it more difficult for those who maintain traditional ways of life to practice these activities. It will make traditional food sources less available and more difficult to access, and will raise issues of food safety. This will force more people to meet their nutritional needs through store-bought food. For food security, an already fragile system can be pushed to the breaking point if action on both the local and regional scale is not implemented. Human dimensions of climate change research has focused on identifying community-level vulnerabilities to climate change impacts in northern communities (Ford et al. 2007, 2010b, Pearce et al. 2009b, Andrachuk and Smit 2012, Ford and Pearce 2012). These studies engage communities in identifying climate change impacts and experiences and work towards community-based adaptations to address these vulnerabilities. It is at the community scale that adaptations are most successful at reducing vulnerability (Ford and Smit 2004) while also providing lessons to other communities in bottom-up approaches to decision-making and implementation (Smit and Wandel 2006).

Extensive research on human impacts of climate change has been undertaken in the Arctic, understandably, as climate warming and related impacts are most severe in this region. As such, this region is very much at the frontier of climate change impact studies. Communities

throughout this region cite numerous concerns regarding the impacts of climate change on access and availability of traditional food sources (Berkes and Jolly 2001, Ford and Smit 2004, Ford et al. 2006a, 2008, Pearce et al. 2009b, 2012, Andrachuk and Smit 2012). Adaptations include changing land use patterns and timing of hunting to coincide with changes in migration and changing seasons (Berkes and Jolly 2001, Ford and Smit 2004, Ford et al. 2008), building shelters and camps on the land, and taking extra precautions to enhance harvester safety (Ford et al. 2008, Pearce et al. 2012). Most interesting is the call for country food species substitutions (Ford and Smit 2004, Ford et al. 2008, Andrachuk and Smit 2012). This may be an issue in some communities due either to lack of alternatives or limited Traditional Knowledge and experience with species not currently harvested (Wesche and Chan 2010). Furthermore, changing to another species that may also be threatened by climate change or anthropogenic impacts might be a short-term fix and lead to jeopardizing populations of the replacement food source (Wenzel 2009).

Promoting more social connections through on-the-land camps, community hunts and mentoring programs are also good adaptations that increases community resilience (Ford et al. 2006a, Pearce et al. 2012, Cunsolo-Willox et al. 2012). Allowing communities to be on the land together and pass on Traditional Knowledge will have positive impacts on many aspects of the community food system. Sharing information on land conditions through radio reports or shared maps is a good way of transferring knowledge within the community to ensure safety of harvesters (Pearce et al. 2012), and also increases community adaptive capacity. Additional sharing of data on migratory patterns and animal sightings may also add to increased success in harvesting among community members, which could benefit more community members through

food sharing networks. Although many of these adaptations can be transferred to other communities across the North, some communities have specific adaptation needs as they face different threats. Each community will need to adapt in their own way based on community capacities and strengths (Wesche et al. 2016). Therefore, adaptation pertaining to changing landscape and hydrological conditions, as well as how communities alter harvesting patterns to address changing migratory patterns and species availability, are important discussions for many communities now and into the future.

1.6 From Adaptation to Resilience

In the social sciences, resilience has been used to describe social-ecological systems in terms of sustainability (Gunderson and Holling 2002, Walker et al. 2004, Olsson et al. 2004, Folke 2006). As such, resilience describes systems that are constantly changing and therefore require constant feedbacks, innovation and information to continually adapt to these changes (Gunderson and Holling 2002). Learning is therefore a key element in the social-ecological system, and the key driver of adaptation (Armitage et al. 2011a, McCarthy et al. 2011). Adaptation can occur through learning based on past experiences, or adaptive capacity, and drives innovation and change (Smit and Wandel 2006). Therefore, resilience can be more than just maintaining a system as it recovers from a disturbance; it can be seen as creating opportunities for transformation to a more desirable endpoint (Davoudi et al. 2013). Northern communities have adapted to local variations and disturbances over time (Berkes and Jolly 2001, Loring and Gerlach 2009) and Traditional Knowledge functions as a form of adaptive management (Berkes et al. 2000). Specifically, the transfer of information through cultural and social practices is how communities have thrived for so long under harsh and variable conditions. Food sharing, use of technologies (from guns and

equipment traded for furs to modern technologies and skidoos) and the creation of the Mixed Economy have been prime examples of adaptations being used to advance communities by capitalizing on opportunities. The issue now is that change has happened so rapidly over the past few decades through social and cultural changes, but more recently with the impacts of climate change, that there may now be limitations to how much more communities can adapt. Loss of Traditional Knowledge and degradation of social networks has led to increased vulnerability (Ford et al. 2006a, Cameron 2012) as the information that maintains the resilience in the system is being lost. Particularly in the face of climate change, where present conditions on the land cannot be explained by past experiences, communities are concerned whether Traditional Knowledge is still relevant (Bayha 2010). Not only are ecosystem goods and services vital to the country food supply, they are strongly linked to culture and understanding of place as well as to community health and well-being. Therefore, communities need the knowledge of how climate change is impacting the land, animals and water, so that they can continue to adapt their food systems to these ongoing changes now and for the future.

1.7 Food Security from a Systems Approach

Shifting from adaptation to resilience integrates a systems-based approach to dealing with the impacts of climate change. Furthermore, it better represents the tight social-ecological system that forms the basis of food systems in the North and the numerous and complex relationships that have emerged with global changes. It may also better represent the complex aspects of northern food systems and the strains that climate change puts on those systems. Many descriptions of sustainable food systems (see Blay-Palmer 2010) do not capture the complexities of northern communities as they neglect harvesters, or communities that rely on hunting and

gathering as a main food source, and focus instead on agricultural systems. A new framework to describe the food system, therefore, is needed.

Over the years, several frameworks have emerged that challenge the current ways of thinking and approaches to rural and community development. The Capabilities Approach emerged as an alternative framework to measuring, and a criticism of, economic metrics as the sole basis for determining well-being (Sen 1993, Nussbaum 2001). Instead, Capabilities Approaches incorporate social, political and economic analyses to argue that communities should be evaluated in terms of what they are capable of achieving (Sen 1993, Nussbaum 2001, Robeyns 2005, 2006). Sustainable Livelihoods (SL) then emerged from poverty, development and vulnerability studies (Chambers 1992, Scoones 1998) as a framework that combined capabilities with capitals, or vehicles of action in making one's living (Bebbington 1999). In essence, SL examine the capitals, capabilities and assets people need to make a living, and these livelihoods are sustainable when they are resilient to outside stresses (Scoones 2009). It is, therefore, an alternative to measuring development through economic factors only, but instead includes factors such as education, health, and ecosystem services used to support communities (Bebbington 1999). The SL approaches include natural, social, human, physical (infrastructure) and financial capitals (Scoones 1998); utilizing this framework, studies have shown not only how rural communities develop , but how they address issues of vulnerability (Adger 2006, Fraser et al. 2011), resource management and conservation (Berkes and Davidson-Hunt 2006, Plummer and Armitage 2006), and climate change adaptation, particularly in developing countries (Connolly-Boutin & Smit, 2016; Nkem et al., 2013). SL approaches have been utilized in Indigenous

communities, predominantly in Australia where issues of development, rights and conservation were examined from a community perspective (Moran et al. 2007, Nikolakis and Grafton 2015).

There have been several critiques of SL, namely that it does not account for changes on a state or global level, where sometimes these changes, described as contexts, were the most important factors at the local level (Scoones 2009). Also, SL fails to deal appropriately with power relationships and governance issues, which can take place at different scales; therefore, SL was never utilized as a tool for political change (Scoones 2009). SL, however, is also limiting as it only examines five capitals that communities access: social, natural, financial, physical and human. The Community Capital Framework (CFF) developed by Flora et al. (2004) is based on seven capitals contained within a community: natural, social, cultural, political, built (same as physical), financial, and human. These capitals are described in detail in Table 1. The CCF adds both political and cultural capitals to the framework, which examine cultural norms as well as local decision making. Past studies do indicate how political capital on a community level can influence regional planning (Emery and Flora 2006), form relationships with regional decision-makers (Flora et al. 2012), and access financial capital from regional and federal levels in the case of disaster relief (Stofferahn 2012). Building of social and political capital led to increased participation and the transfer of power to communities in protected area management and tourism development in rural Africa (Stone and Nyaupane 2015) and agroecotourism in Cuba (Duffy et al. 2016). CCF, therefore, deals with issues of scale through the building of social and political capitals at the community level, which are fostered by financial capital, in order to access regional resources such as assistance (Turner 1999). Essentially, through mobilization of social and political capital, communities have created organizations (both formal and informal)

to advocate on behalf of the community, and represent them and give them a voice on a regional level (Turner 1999, Fey et al. 2006, Stone and Nyaupane 2015, Duffy et al. 2016). This community group, therefore, acts as a Civil Society Organization (CSO) that has been instrumental in advocating for changes in food systems and rights in Canadian and international contexts at city, regional and state levels (Blay-Palmer 2016). In essence, the CCF deals with scale when several conditions are met, including access to financial and political capitals, along with both bridging and bonding social capitals – allowing for a community to network with other partners and organizations to influence policies at different scales.

The CCF has not been used as a food system model and has been used only as a tool in community development, resilience, and planning (Emery and Flora 2006, Ashwill et al. 2011, Stone and Nyaupane 2015). Viewing the CCF through a food system lens allows for a more comprehensive look at the factors that influence a community's food system. The CCF examines how a community draws upon each of the seven capitals to achieve community well-being and sustainability (Flora et al. 2004). This can easily be extrapolated to food and issues of food security, particularly within Indigenous communities as definitions of health and well-being take on a more holistic meaning. The Dene Way of Life describes the close relationship to the land, being on and living off the land, but also includes elements of self-governance, practicing cultural and spiritual traditions, and the social network and support of families and the community (Bartlett 2005, Parlee et al. 2007) – describing many of the capitals present in the CCF including natural, cultural, social and political capitals. The addition of financial and built capitals reflects the more modern needs of tools, equipment and supplies required to access the land (Council of Canadian Academies 2014).

The CCF also highlights factors that are underrepresented in other food system descriptions. For example, the inclusion of cultural customs and linkages, such as food sharing, play a major role in these communities, both in terms of food security and their sense of place and identity (Wilson 2003, Cunsolo-Willox et al. 2012). These are captured as part of cultural and social capitals. Instead of farmers or harvesters, the CCF examines human and built capitals that capture skills and tools needed to access food. Complex issues such as rights to land and decision-making ability in terms of land stewardship and resources fall under political capital, while the impacts ofclimate change on natural capital also fall under this framework. The CCF, viewed as a representation of a food system, captures more of the complexities that exist in northern communities and is a more inclusive way of representing food systems more broadly.

Complexity is also a theme emerging in food systems literature. A Complex Adaptive System (CAS) framework has been used to describe food systems in northern Ontario Indigenous communities (Stroink and Nelson 2013). Stroink and Nelson (2013) argue that food networks can be viewed as a series of interconnected systems that are each a part of their own system and function across scales (Stroink and Nelson 2013). The capitals of the CCF can be viewed as interconnected systems, as each dynamic and evolving and driven by a combination of multiple factors. CASs also alleviate issues of scale, which can limit SL approaches, as systems can exist at multiple scales (Westley and Antadze 2010) and can be impacted by emerging properties across scales (Stroink and Nelson 2013). Similarly, System of Systems (SoS) approaches have gained traction in food systems literature (Hipel et al. 2010, Blay-Palmer et al. 2015). SoS are "large scale concurrent and distributed systems that can be composed of complex systems…all

SoS involve CAS" (Hipel et al. 2010 p. 4). However, SoS are grounded in the values and ethics of the community and are therefore tools for policy design (Hipel et al. 2010), adding dimensions of place required in food systems (Marsden 2012) and individual approaches for determining solutions to complex problems. In terms of building sustainable food systems, SoS "support and enable the policies, structures and institutions needed to improve the integration of environmental, economic, material, political and social priorities" (Blay-Palmer et al. 2015 p. 4), which again speaks to the community capitals. Using the CCF as a SoS framework helps to further define what systems are involved (capitals) and, if applied, can help overcome the other limitation of the SL approach: that it is limited in its ability to foster political change (Scoones 2009). A new approach to food systems work in the North can help define the strategies and policies needed to address some of the complex issues of food insecurity and build a more sustainable future for northern communities.

1.8 Research Objectives

This research has five objectives:

1) To better define and understand the complex northern food system using the Community Capitals Framework (CCF);
2) To conduct case studies with Indigenous communities in the NWT by identifying food system vulnerabilities to the impacts of climate change with a focus on harvesting practices and country food security now and in the future;
3) To identify community-based programs and initiatives to adapt and build resilience into the food system for future generations;
4) To identify adaptation strategies currently employed or possible for future application by community members to mitigate any adverse impacts to traditional harvesting practices

and community health and well-being, and;

5) To offer practical examples of how Participatory Action Research (PAR) can empower communities to adapt to the impacts of climate change and build more sustainable food systems.

1.9 Overview of Chapters

This thesis is organized into six chapters and follows the multiple manuscript option for PhD dissertations. This 0chapter serves as the introduction to the thesis, while research design, approach and methods are outlined in Chapter 2. Data chapters (3 – 5) are presented in a form suitable for publication in a peer-reviewed journal. Chapters 3 and 4 present case studies examining the impacts of climate change on food security, as well as community based adaptations and solutions to build a more sustainable food system in the communities of Kakisa and Dél̨nę respectively. Both case studies use a participatory action approach to engage community members in the research process, and use the CCF to identify community strengths and needs to address issues of food security. Chapter 5 provides a comparison between these case studies and examines how issues of place, scale and space shape the food systems in these communities. And finally, Chapter 6 offers some concluding thoughts on the research presented in this thesis and proposes next steps for addressing food insecurity issues in the North.

2 Methodology

2.1 Introduction

This chapter outlines the approach, frameworks and methods used to carry out this research. It should be noted that this thesis does not use an Indigenous framework but rather uses a current tool in a current context within an Indigenous community. This chapter begins with a discussion of the personal research approach and positionality of the researcher. Critical theory is then discussed as a theoretical framework for the research, and how participatory methods and food security issues in the North fit into a post-colonial research approach. The importance of case studies and details of how each case in this research evolved out of different relationships and networks of people in the NWT are discussed. Data collection methods are then highlighted, specifically participant observation and semi-structured interviews, followed by a discussion on the data analysis and reporting that was conducted. Most importantly, a reflection on the strengths and barriers identified as part of this participatory methodology is outlined, highlighting how others can learn from the approach taken as part of this research. A summary of key points is also presented.

2.2 Positionality and Personal Approach to Research

As a researcher, I bring biases into my work. These biases are due to my past experiences, be they academic, educational, or cultural as well as my age, race and gender. Reflecting on my role as a researcher and what my biases are is critical to my research approach (England 1994). I have experienced how these biases have shaped my research experience in both positive and negative ways. As a researcher, one must wear different hats under different circumstances. Through the process of this work, I have been the "Expert", and have been asked for my opinion,

or for answers to questions that community members have on a diverse range of topics, from science, to engineering, to running a UNESCO Biosphere Reserve, when people find out my background. I have been the "Teacher", working with youth and sharing some of my knowledge of climate change, ecology and mapping. I have been the "Student", patiently listening and watching as an Elder shows me how to dry fish, set nets or tell a story. Most importantly, I have been "Andrew" who gets invited for coffee at the kitchen table with community members, and shares texts and Facebook posts with friends in the communities. "Andrew" gets teased by the women in the Band office, and shares a laugh or a story in the hallway with a community member. "Andrew" helps to build gardens in remote communities, applies for funding and makes time to help communities along their path to self-sufficiency. To me, being called "Andrew" in the community is the sign of acceptance and trust, and where I want to position my work to create positive change in communities. However, I have also been a "mǫ́la" – a term that is often used to describe non-Dene, or white people. To be called this means you are an outsider, and represent that colonial past. This term, to me, is a sign of failure, and it signifies that my work is not making an impact in the community, nor is it building trust among participants. It is a reminder that some of these past experiences still impact people today, and, most importantly, some of these colonial practices are still occurring, which creates distrust in communities and impacts the research I do there. Research, particularly social science research methods, in Canada's North has evolved (Caine et al. 2009, Angell and Parkins 2010). But there is a history of northern communities being studied using prescriptive and colonial approaches. Western ways of knowing and research methods created an unequal distribution of power, and a lack of respect for traditional ways of knowing, and exploited participants and Traditional Knowledge (Angell and Parkins 2010). This is the legacy that I do not want my research to

represent, and, therefore, this chapter will detail the methodology and approaches I used to conduct this research in hopes of contributing to a new paradigm of research in the North.

2.3 Theoretical Framework - Critical Theory

As a self-proclaimed "action researcher", my expertise and experience has always focused on the "doing" and not necessarily the theory behind the actions. However, it is that approach, through action research, that is linked to critical theory and that scholars can become involved to help drive social change (Soja 2010). "Action research and critical social science embody participatory democratic processes for social and intellectual reconstruction" (Kemmis 1980, 12). Critical Theory, and therefore critical research, empowers individuals to confront injustices in society where researchers cast aside their neutrality for action (Kincheloe et al. 2011). However, critical theory is broad, and has seen many related theories emerge from it. Specifically, and where my research fits best, is post-colonial theory that rejects the colonial approaches and looks to ways of shifting power back to communities (Sidaway 2000, McClintock 2009). Issues of food insecurity in Indigenous communities are linked to past and current colonial experiences; therefore, a post-colonial approach, one which examines the systems and the history behind the current socioeconomic and political issues, is needed to reimagine these systems to empower communities to build more sustainable and just food systems (Sidaway 2000, Anderson et al. 2005, Blay-Palmer et al. 2015). Essentially, this post-colonial approach underlines the need to examine issues of food security through a different lens, which is the focus of my research.

2.4 Conceptual Approach – Community-based Participatory Research and Participatory Action Research

Community-Based Participatory Research (CBPR) focuses on the needs of community, fostering collaboration and promoting knowledge sharing. It engages community members as researchers, investigators and partners in co-learning (Gilmore et al. 1986), and prioritizes spending time and building trust in the community and creating opportunities to involve communities in the research process (Tondu et al. 2014). Supported by others working in northern communities, much time and effort during the early stages of research is spent in the community, getting to know community members, but, more importantly, letting them become familiar with the researcher (Caine et al. 2007, McGregor et al. 2010). Themes of listening and respect resonate through the literature as ways of building trust (Burke 2005, Grimwood and Donaldson 2012, Tondu et al. 2014). This trust can lead to initial participation, which can pave the way for more meaningful interaction over time.

Participatory Action Research (PAR) differs slightly from CBPR in that it strives to achieve social change and transformation (McTaggart 1999). With origins in community empowerment, social action and community health and development (Wallerstein and Bernstein 1994, McTaggart 1999, Altrichter et al. 2002), PAR methodologies have been used in building food systems across Canada (Blay-Palmer et al. 2013), including Indigenous communities (Skinner et al. 2013, Stroink and Nelson 2013). Consistent with other work in the North (Berkes and Jolly 2001, Pearce et al. 2009a, McGregor et al. 2010, Armitage et al. 2011a, Tondu et al. 2014), work is done alongside representatives of community, observing – but also contributing to – their activities in order to provide answers to important community-defined questions. Participatory

approaches acknowledge that communities have local knowledge that is crucial to understanding and addressing the issues and problems they face (Flicker et al. 2008). Sharing these experiences and good practices with other communities can be the foundation of a global network of communities working towards building more sustainable food systems (Holt-Giménez and Shattuck 2011, Blay-Palmer et al. 2015).

Participatory research is not without its issues. Often, researcher goals, academic timelines, or funding requirements and community needs do not always align (Caine et al. 2007, Christensen 2012). Engaging communities and informing decision makers is often a requirement of funding calls but are not always the focus of the research or priority of the research team (Ford et al. 2013a). These interactions can then lead to communities feeling co-opted and wary of researchers who mine Traditional Knowledge, using it elsewhere (Nadasdy 1999, Caine et al. 2007, McGregor et al. 2010). Past negative experiences with researchers erodes trust in other researchers and the research process, regardless of discipline, intent, or approach. However, research, for the most part, is transitioning to be more inclusive of community needs (Angell and Parkins 2010). Community participation in research can occur in many stages, building collaborations and community capacity over time, eventually leading to participatory action research where communities drive the research and academics take a supportive role. There are some communities where initial collaborative work has evolved over time. In Old Crow in Yukon Territory, community-based research was successful due to a strong relationship built with the community, as well as an increased capacity, and leadership to carry out such studies (Wolfe et al. 2011, Wesche et al. 2011). In Old Crow, and perhaps a handful of other communities, researchers have built enough social capital and trust to become successful

partners in PAR. Participatory research can be a long-term process, with patience, flexibility and transparency required to nurture collaboration.

2.5 Research Design – Comparative Case Study

Case studies let us explore individual events, processes or phenomena in great detail with the purpose of understanding such events or phenomena on a broader scale. Multiple case studies provide a broader context for exploration and explanation of theory and phenomena. Comparative case studies incorporate a spatial component, meaning the phenomena studied in one area may be different in another due to the place itself (Hay 2010). That said, other circumstances, such as available capitals, also play a role in determining the community's food system. This research involved the comparison of two cases: Kakisa and Délı̨nę.

2.5.1 Case Study Selection

In 2013, when the idea of this research was proposed, there were a few key restrictions to moving forward: no project and no funding. As my advisor had no formal connections or collaborations in the NWT, these needed to be built for the research to progress. Other researchers at Wilfrid Laurier University (WLU) had, in fact, built a number of important connections in the NWT, predominantly through a network of physical and natural scientists. There were also concerns from communities and interest from the territorial government (GNWT) on issues related to food security that were not being addressed through the existing work. The WLU-GNWT Partnership Agreement was signed in 2010 with the aim for WLU researchers to build capacity for the NWT to conduct environmental research and monitoring. With this partnership, a Community Liaison position was established to connect WLU

researchers with government departments and researchers, organizations and communities. The person to fill this role, initially, had a background in community development and had previously been the Executive Director of Ecology North, a non-governmental organization that works on issues of outreach and education in the NWT. As such, the Community Liaison had a great deal of experience working with and in communities throughout the territory, and had built many contacts and connections. Early discussions with the Community Liaison centered on issues of community concerns about changes to the climate in the region. Utilizing the Community Liaison's social capital, we were able to make connections to the Ka'a'gee Tu First Nation (KTFN) in Kakisa, and to the Sahtú Renewable Resources Board (SRRB) that represents the five communities of the Sahtú, one of which is Délı̨nę. Through initial discussions, these partners expressed their desire to address issues of food security in their communities, and their interest in collaborating with WLU to work together to achieve these goals.

Working in two communities represented an interesting opportunity, as well as challenges. One concern was that building of new relationships in two communities where no formal collaboration had existed previously would take considerable time and effort, and there was a risk that the research may not fall within the given timing to conduct proper case studies. Particularity with participatory research, if the communities had different priorities and goals for the research, case studies may not be appropriate for comparison. The experience in Kakisa started as Ecology North and the Ka'a'gee Tu First Nation were applying to the Health Canada Climate Change Adaptation fund for a project on food security and climate change and we were asked to help support the application. Early in 2014, the application was approved for the proposed research in Kakisa and we were able to move ahead with research planning and ethics

approvals. Work in Délı̨nę evolved differently. Initial consultation with community partners in the Sahtú revealed that an existing project on the Traditional Economy needed support. We were able to contribute to a literature review on the Traditional Economy, which encompasses traditional food harvesting and gathering, fur trapping, and arts and crafts. This work provided the opportunity to visit Délı̨nę in February 2014 to take part in the regional workshop on the traditional economy with members from the Sahtú communities. This provided the opportunity to interact with community members and discuss issues related to food security as part of the Traditional Economy work. This formed the basis of a relationship with the community partners and kept an open dialog as opportunities arose. Later that year, we were asked by community partners to put together a proposal to the Health Canada Climate Change Adaptation fund, the same fund accessed for the Kakisa work, on behalf of the community. In development of that proposal, it was agreed with community partners that the scope of the work would be similar to that ongoing in Kakisa. This presented the opportunity to conduct a comparative study between these two communities. Where Kakisa was already one year into the project at the time the work in Délı̨nę started, it presented the chance to learn and modify approaches, where appropriate, but also to share knowledge and experiences.

2.6 Data Collection

A mixed methods approach is also the foundation of this work. It can be described as a process where several methods of data collection are applied, that can be qualitative, quantitative or a mixture of both (Creswell 2013). In this research, several different qualitative approaches were utilized to capture community experiences with climate change and health, and to empower

communities to envision programs to make the community food system more sustainable. These methods are described in the following sections.

2.6.1 Community Engagement Events

Community engagement events were used extensively during this research to build community interest, participation and trust between the researcher and the community. They were, in a sense, modified focus groups, where a facilitated discussion with small groups of participants took place (Hay 2000). This technique allows for a conversation to emerge where both researcher and participants gain insights during the research process (Goss et al. 1996). These events are also effective tools to empower participants in the research process (Swenson et al. 1992). As part of this research, these events were not used for data collection, per se, but as a tool for community engagement and trust-building, and to refine research goals, methods and questions (Swenson et al. 1992, Goss et al. 1996). A few different examples of this modified focus group approach were used in this research. For example, in August of 2014 we were able to host a meeting in Kakisa to introduce ourselves, and the project, to the community. It was felt that the community needed to have the opportunity to come together after the traumatic events of the summer when the community was evacuated for a two-week period due to a forest fire. The "kick-off" meeting was envisioned to be an informal gathering, with food, to enable the community and researchers to meet and interact. Held over lunch, approximately 20 community members attended. Around the room, there were maps of the area, with some showing aerial photography taken as far back as 1970. Informal discussions over how the land has changed, how people use the land, and other topics were held between the researchers and small groups of interested community members. This opportunity to meet helped to inform research topics to

explore during the interviews, and helped the researchers gain insights into the relationship between community members and the land. Most importantly, the event was about building a relationship with the community and making it clear that we, as researchers, were there as part of a partnership with the Band to help the community. In another example, an introduction workshop was planned to take place prior to interviews in Kakisa in November 2014 to focus on why the research was being conducted and highlight the partnerships between the community and researchers. During the workshop, preliminary discussions of what had changed over the past years were held and participants were able to share their experiences and concerns as a group. This initial discussion allowed participants to reflect on some of the topics to be discussed prior to the interview. The research team, which included research and community partners, was able to answer questions about how the research was going to take place and reassure those who had never been a part of this type of research before.

In Délı̨nę, community engagement events started in the Spring of 2015 in the form of conference calls as a way to keep community members engaged in the planning of the project. The purpose of these calls was to introduce the researcher to participants, and allow community members to become familiar with the research process, including interviews and on the land trips. These calls often included discussion on climate change and issues and community concerns around food, providing insights to the researcher. The numbers of participants on the calls ranged from 10 – 30 people who were selected by community partners and included Elders, experienced harvesters, and youth (individuals in their early 20 and 30s). In September 2015, another meeting was held in the community prior to the interviews and involved logistical planning for the on-the-land trip as part of the research. Furthermore, due to the busy meeting schedule that is

the norm in Délı̨nę, the research team, which included myself as well as individuals from partners organizations and community members, were also able to incorporate discussions on the food security research into several other calls and meetings, keeping the research project on people's minds.

2.6.2 Participant Observation

Based on participatory action research methods, the researcher engaged with participants in co-learning and through the concept of two-eyed seeing: "To see from one eye with the strengths of Indigenous ways of knowing, and to see from the other eye with the strengths of Western ways of knowing, and to use both of these eyes together" (Bartlett et al. 2012 p. 355). Therefore, learning more about Indigenous ways of knowing was the priority during much of the research, and participant observation allowed for this to happen. Participant observation occurs when the researchers place themselves in a situation where the understanding of place can arise (Hay 2000). In Délı̨nę, for example, an integral aspect of the project was two on-the-land camps taking place during the fall and spring research visits. These camps helped facilitate both meaningful opportunities for community members, particularly youth, to be on the land to learn skills from their Elders and harvest foods to bring back to others in the community. This learning environment allowed the researcher to gain a deeper understanding of the culture and traditions of the community and led to more research questions, interactions and dialog (McGregor et al. 2010). These opportunities also facilitated informal discussion on research topics and the building of trust and relationships (Tondu et al. 2014) and embodied the spirit of participatory action research to achieve both research and community goals. Participant observation was a key method of obtaining data for research as it created an informal space where the researcher

and participants could interact and share experiences and knowledge. These events added to the depth of understanding of the history, culture and people who were part of the research process.

2.6.3 Semi-structured, Open-ended Interviews

Semi-structured interviews were the primary method of data collection in this thesis. Interviews can be structured around organized questions, but also be flexible to further explore more detail based on specific experiences and expertise of the participant (Hay 2000). Furthermore, questions can be modified to suit the participant. For example, Elders were asked to tell stories about their experiences on the land from the past (Legat 2012), whereas current land users were asked questions more relevant to present experiences and recent environmental changes (what they see and how it has changed over the past few years). Community members who were able to speak to changes they have experienced on the land, which included Elders, harvesters and others, were selectively sampled and invited to participate in the interviews (Mays and Pope 1995). Community partners initially identified participants who they thought were appropriate, and willing to participate, while other participants were identified during ongoing consultation with those already interviewed and community partners (snowball sampling). Each interview was planned to take approximately one hour, was digitally recorded, and participants were reimbursed for their time.

Interviews were conducted in Kakisa in November 2014. In all, 21 community members were interviewed over the span of approximately one week. Interviews in Délı̨nę were conducted in September 2015 and included 13 community members. The difference in participation in communities may be attributed to time and availability of participants, as well as a shorter

window that interviews were conducted in Délįnę due to weather constraints. As well, the role of the community partner in Kakisa played a large part as they were able to marshal a greater number or participants due to their social capital and connections within the community. In both locations, interviews were held in meeting rooms or, if preferred by participants, other locations around the community. A translator was present during interviews to ensure participants could speak in their preferred language (South Slavey in Kakisa and North Slavey in Délįnę). For all interviews conducted in North or South Slavey, an interpreter was used to consecutively translate questions and answers. Both communities were asked similar questions about health, changes they have witnessed on the land over the past few years, and how these changes were impacting the community. Most important, from a PAR perspective, were questions about what participants thought the community could do to overcome some of the barriers identified to build a healthy community. The questionnaire utilized in both communities is presented in Appendix A.

2.7 Data Analysis, Validation and Community Reporting

Audio recordings were transcribed verbatim, and checked by the research team to ensure quality. After interviews were transcribed, transcriptions were read through carefully to gain a full understanding of the contents of the interviews. A general discussion amongst the research team helped to identify themes and coding structure (Mays and Pope 1995, Bradley et al. 2007). Ensuring rigour of the research is an important step in the participatory process and ensures the trustworthiness of the work (Hay 2000). Communities, therefore, must have the opportunity to check the work to assure quality of work, and ensure that participant views expressed are a reasonable representation of their experiences (Mays and Pope 1995). This was done in several

different ways during the research. First, preliminary results of the study were presented to the community during a results workshop which occurred soon after results were available, and was subject to availability of community members. This workshop allowed for community members to comment on the findings prior to the finalization of reports and also created the opportunity for individuals to approve any direct quotations being used in reports and publications. In situations where the participants spoke Slavey, we ensured that a translator was present to effectively communicate the findings to those individuals. As part of these events a discussion and prioritization of next steps in the research took place, as well as an opportunity to reflect on what worked and what did not. This highlights the iterative and reflective nature of participatory action research, and transferred more ownership of the research to the community (Smith et al. 2009).

Making the results accessible to the community was also a priority. It is one way of showing tangible results of the research partnership. In both communities, reports and individual follow-up plans were developed based on discussion and community priorities, and shared with the community. An example of a community plan is given in Appendix 2. Through follow-up calls, meetings and visits, community support was obtained for these plans to become the focus of research and potential grant applications in each community. Another, more powerful, illustration was to build and implement some of the initiatives that were discussed in the community. In Kakisa, for example, the priority was to start growing food in the community. That summer we were able to secure garden boxes and soil from the regional government offices and plant a small garden for the community. In Délı̨nę, the work directly contributed to a young harvester training and scholarship program enacted by the community. These successes are personal highlights of

my research as it was a physical representation of the participatory action research process that directly influenced change in the community.

2.8 Strengths, Issues and Considerations

It would be a mistake to lead the reader into a sense that this research was conducted in a highly organized and structured fashion. Although much of this work was built upon good intentions, much of this work progressed in an ad hoc way, capitalizing on opportunities to move the research forward, reorganizing plans, and maintaining flexibility - all while maintaining the spirit of participatory action research. During this research, some unique elements helped while some issues hindered progress. This subsection will explore and discuss some of these issues.

2.8.1 The Community Leadership

One of the innovative elements of the methodology used here is the partnership, and personal relationships, built with the Environmental Coordinator in the community of Kakisa, Melaine Simba. This individual has been involved in environmental monitoring projects through government departments and non-governmental organization, and has coordinated field sampling for fish, water and wildlife monitoring with government and university researchers. As such, the Environmental Coordinator has a high capacity to conduct research and was adept at providing logistical support for this project, both of which were keys to its success. Of most benefit to the project was the social capital and connections this person has in the small community which allowed for easy communication and connections to community members and local decision makers (Chief and Band Council). Their affinity for social networking and text messaging led to increased and timely communication and interaction in the community, which allowed the

project to proceed at a more rapid pace, especially when dealing with last-minute logistical challenges and accommodating community needs. What emerged as a powerful driver behind the research and subsequent follow-up projects was their personal drive to conduct work that made a positive impact in the community. This drive not only enabled them to champion the research, but pushed much of the research beyond mere participatory and collaboration to action research. This relationship helped to foster research links outside of the community and the Environmental Coordinator attended meetings in Waterloo, Ontario, with research partners from around the globe, and was able to help shape further grant applications and collaborations. Having a community member or a local organization as part of the research team not only fosters community participation, but also provides a point of contact in the community at all times who can be a resource to other community members and a conduit for communication (Brook et al. 2009, Wolfe et al. 2011). Of course, finding the right person for this job can be difficult, based on appropriate training and personal initiative (Pearce et al. 2009a). But this overcomes several major barriers for researchers working in the North, specifically the limited time one has to spend in the field, and builds upon the social capital of an individual or partner organization within the community (Caine et al. 2007). The positionality of the Environmental Coordinator made a significant contribution to the overall project and speaks to the importance of building capacity and empowering communities, and for local leaders to be active members of the research team and to enhance participation of community members.

The community leadership position was not present in Délı̨nę, or at least not in the same capacity. During interviews we identified one participant, a young male, as a very well-spoken and thoughtful individual who wanted to see positive things done in his community. This

individual was hired onto the project with the vision of building his capacity to conduct research and support community initiatives in the long-term. However, as is often the case in northern communities, people with drive and enthusiasm can become over-utilized and burn out. Although we were able to work together effectively for the duration of the research, we lost the potential to continue the position to help drive future community research and actions. This was particularity evident in delays in the community being able to validate quotations and reports. However, one must consider that the research presented here is a sample of the work going on in the community, and other community priorities and projects can often take precedence. Learning how to continue to be available and contribute in other ways was an important lesson in work in Délı̨nę.

2.8.2 Building a Network

Another key element of the research was the partnerships built with communities, organization and government agencies. Part of building resilience and fostering food system development is to build social capital by fostering connections and networks within, as well as outside of, the community (Blay-Palmer et al. 2015). Also known as bridging social capital, this strong network of organizations, where each partner brought their own expertise to the research team, was able to leverage other networks and funding, and bring diverse experience in similar or related work to the community (Putnam 1995, Emery and Flora 2006). Much of my early work started with phone calls and meetings with key players in food research in the NWT. Utilizing our connection with the GNWT, discussions with communities and other organizations on issues of food security soon materialized. Involving these groups, such as Ecology North, in the research help to foster linkages to a broader network of organizations and individuals working on

or concerned about food security issues. This broader network became important after the initial research was conducted and community-defined projects were prioritized. As funding sources were identified, different partners that were more suited for specific grants were put forward as the proponent with the other groups offering letters of support and assistance in writing, and with the community having final approval on all grants moving forward. This partnership leveraged the capacity of other groups to target and obtain funding sources for the community in a way that benefited all groups involved. Furthermore, it allowed for those partners from the NWT to become more involved, building connections and expertise to solve issues facing northern communities. This network, although still developing, can serve to both scale up initiatives (Friedmann 2007, Mount 2012) and better represent the voice of communities in developing relevant policy at the territorial and federal levels (Anderson 2008, Levkoe 2011).

Another type of network that was created was one between natural and physical sciences and social science as depicted in this research. Research in the NWT was identified as a strategic priority for WLU and, therefore, the institution allocated significant resources to developing research opportunities. Working through predominantly natural science-based opportunities, collaborations between social and natural / physical sciences began to emerge. As funding opportunities now outline the need for more community engagement and participation, lessons learned and examples from this work were able to assist other researchers in their own work. For example, working with forest fire researchers resulted in a unique opportunity to conduct outreach events with the school in Kakisa. Utilizing the social capital created as part of this research, other researchers were able to directly interface with the community, creating a more interdisciplinary approach to community-based research. This can lead to building more trust in

science (Whitman et al. 2015) and enhancing collaborations with local agencies which can be key to achieving success on the ground in conservation initiatives (Smith et al. 2009). Alternatively, being linked to these natural science networks enhanced the transfer of knowledge to communities. Questions by community members could be readily answered through these connections, enhancing adaptation and adaptive capacity through the flow of information between groups and individuals (Adger 2003).

2.9 Summary

Research in Indigenous communities has been changing in recent years. Participatory research is driven by Indigenous research questions, and empowers communities to create positive change. The approach detailed here summarizes the methods and framework utilized during this dissertation. This research was as much about building personal relationships and networks as it was based on theoretical approaches and methodology. Opportunities for collaboration and research emerged through these informal connections and linked directly to community needs. This approach was a learning experience: many issues and obstacles were encountered, but many lessons were learned. Themes of listening and trust building emerged, as did patience and flexibility. However, this approach and the research have already begun to create positive change in communities and has built long-term relationships. It is hoped that this approach can be used as a "good practice", highlighting an approach that may be useful in other communities, and provide lessons to other early career researchers looking to work in the region.

3 Climate change, community capitals, and food security: building a more sustainable food system in a northern Canadian boreal community

(Manuscript accepted to Canadian Food Studies, April 2017)

3.1 Abstract

Canada's North offers unique food systems perspectives. Built on close cultural and spiritual ties to the land, the food systems within many northern communities still rely on the harvesting and gathering of traditional food and function through the sharing of food throughout the community. However, social, economic and environmental pressures have meant that some communities rely more on food purchased from the stores, which can be unhealthy and expensive, leading to high rates of food insecurity and chronic health problems in many communities in the North. Northern communities are now dealing with the impacts of climate change that are increasing pressure on the food system by limiting both access to the land and the availability of traditional food sources. This research presents a case study from the northern Canadian boreal community of Kakisa, Northwest Territories. Using a Participatory Action Research (PAR) methodology, community members play an active role in identifying threats to the community food system, as well as developing community-based solutions to foster adaptation and transformation of their food systems to become more resilient to the impacts of climate change. By using the Community Capitals Framework to identify multiple stressors on the food system, this research illustrates how a community can allocate available capitals to adapt to the impacts of climate change as well as identify which capitals are required to build a more sustainable food system.

3.2 Introduction

Throughout Canada's North, Indigenous people and ecosystems are linked together. This close relationship with the land and an understanding of natural variability inherent in the ecosystem has enabled communities to thrive. The land is a source of cultural and spiritual well-being, and is also the foundation for community food systems, which continue to be based on subsistence harvesting – hunting, fishing and gathering – and function through social and cultural customs and traditions, such as food sharing (Condon et al. 1995, Collings et al. 1998, Chabot 2003, Abele 2009, Collings 2011, Dombrowski et al. 2013b, Skinner et al. 2013). Community food systems have needed to adapt and change over time, mostly to seasonal changes on the land, migration and availability of animals and other local variables (Berkes and Jolly 2001, Kofinas et al. 2010). Traditional Knowledge, a place-based system of knowledge based on practice, experience and belief regarding the close relationship between humans and the environment, functions as a form of adaptive management that has allowed communities to continually adapt and thrive in this sometimes harsh environment (Berkes 1999, Berkes et al. 2000, Parlee et al. 2005, Armitage et al. 2011b). The relationship between communities and the land has been changing, however, and with it the food system people rely upon. Numerous broader issues such as social, economic, and, political factors, have, and continue to, shape communities and food systems in the North (Furgal and Seguin 2006, Ford et al. 2006a, Loring and Gerlach 2009). These issues include colonialism and the transition into settlements driven by government policies, the introduction of the wage-based economy, and land and resource rights (Power 2008). Global change, which encompasses both environmental and societal changes, has deeply impacted Indigenous communities, and as a result, individuals depend less on the land for their livelihoods and more on the market economy to meet their needs (Loring and Gerlach 2009).

The need for income is now crucial due to the high cost of living in the North, but employment leaves less time to participate in traditional activities. With less time spent on the land accessing the traditional economy and harvesting traditional food, communities become more dependent on store-bought foods and other goods and services.

As a consequence, past decades have seen a transition in the diets of Indigenous communities in the Northwest Territories (NWT), and across the globe, moving away from traditional food sources to food purchased from stores (Kuhnlein and Receveur 1996, 2007, Popkin 2002, Kuhnlein et al. 2004, Council of Canadian Academies 2014). This change is having a negative impact on the health of communities as purchased food often provides less nutritional value, more energy in the form of carbohydrates and fat than traditional diets, and has been linked to increases in diet-related disease such as obesity and diabetes (Receveur et al. 1997, Kuhnlein et al. 2004, Kuhnlein and Receveur 2007, Johnson-Down and Egeland 2010, Egeland et al. 2011, Gagne et al. 2012). However, as the high cost of food and lack of affordable, nutritious options are major barriers to food security in the North, the high cost of supplies and equipment needed for harvesting food from the land are also important factors to consider (Council of Canadian Academies 2014). Also of concern is the fact that some youth are not participating in traditional practices, offering fewer opportunities for transfer of knowledge from Elders. As a result, youth often lack the skills needed to survive on the land and bring back food for the community, which puts additional stress on the community's ability to access and share food from the land (Power, 2008; Pearce et al., 2009; Beaumier and Ford, 2010). As a result, food systems that have emerged are complex, involve multiple factors and stressors, and reflect the rapid social, cultural, and political changes that communities have undergone over the last several decades. These food

systems are poorly understood and the barriers that communities face in meeting their nutritional needs has led to alarming levels of food insecurity measured at 24 – 69% across the North (Rosol et al. 2011, Council of Canadian Academies 2014, Tarasuk et al. 2016).

To compound the barriers that northern Indigenous communities face in achieving food security, the impacts of climate change are rapidly affecting ecosystem form and function in the region. Permafrost thaw, increases in food web contamination, changing migratory patterns of animals, increases in intensity and frequency of wildfire, and changes in hydrology all impact access and availability of traditional foods (Nickels et al. 2006, Ford et al. 2006a, 2008, 2010c, Guyot et al. 2006, Pearce et al. 2009b, 2015, Andrachuk and Smit 2012, Wakegijig et al. 2013, Chen et al. 2013, IPCC 2014), with many of these issues projected to intensify in the future (Price et al. 2013, IPCC 2014). But the impacts of climate change go further than disruptions to the ecosystem goods and services, threatening other services and infrastructure communities depend on (Prowse et al. 2009). Therefore, the food systems that are currently strained to provide access to adequate and affordable food are also vulnerable to the impacts of climate change and constitute an important challenge for communities in the North.

The focus of this paper is twofold: 1) to use a novel approach to describe a food system in a northern Indigenous community that will better reflect the unique socio-economic and political landscape experienced as well as the impacts and pressures of a changing climate. 2) to offer a case study in participatory research that serves to empower community members to make positive changes to their food system in the face of climate change. This study utilizes the Community Capital Framework (CCF), developed by Flora et al. (2004) and built upon rural

sustainability and livelihoods work by Scoones (1998) to describe the food system in a northern Canadian Indigenous community. Sustainable Livelihoods examines the capitals and assets people need to make a living, and these livelihoods are sustainable when they are resilient to outside stresses (Scoones 2009). Under a livelihoods approach, climate change is a stressor, but one of many that can impact several systems. The capacity for people to adapt to this stressor relies on their ability to access different capitals, which are also impacted by the same systems (Connolly-Boutin and Smit 2016). Sustainable Livelihoods approaches are emerging as a focus of climate change adaptation literature and food security studies (Levine et al. 2004, Nkem et al. 2013, Connolly-Boutin and Smit 2016, Penn et al. 2016) as they acknowledge the needs of the people involved, and not just the issues and solutions (Levine et al. 2004).

The CCF differs slightly from other Livelihoods approaches in that it is based on seven dimensions of capital contained within a community: natural, social, cultural, political, built, financial, and human (Table 1). Each of these capitals can be viewed as individual systems that interact with one another and can be used to create capitals or resources that contribute to healthy, vibrant communities, economies and ecosystems (Flora et al. 2004, Emery and Flora 2006). This approach is comparable to other emerging definition of food systems, including complex adaptive systems (Stroink and Nelson 2013), and systems of systems (Hipel et al. 2010, Blay-Palmer et al. 2015) and are defined by place and local circumstances (Marsden 2012). By using the CCF, however, these complex systems are named in terms of the seven different capitals, providing a starting point for analysis of food systems and discussion. CCF has been utilized in community development, resilience, and planning (Emery and Flora 2006, Ashwill et al. 2011, Stone and Nyaupane 2015) but this case is used to represent the factors that influence

the food system. Adaptations are most successful at reducing vulnerability at the community scale (Ford and Smit 2004), which means sharing these examples and case studies can provide lessons to other communities in bottom-up approaches to decision making and implementation (Smit and Wandel 2006). Adapting local food systems to become more resilient in the face of climate change is therefore key to the long-term future of communities in the North.

Table 1. Description of Community Capitals (Source: Flora et al. 2004).

Capital	Description
Social	Connections and networks among people and organizations or the social glue to make things happen.
Cultural	Reflects the way people "know the world" and how to act within it. Cultural capital includes the dynamics of who we know and feel comfortable with, what heritages are valued, collaboration across races, ethnicities, and generations. Cultural capital influences what voices are heard and listened to, which voices have influence in what areas, and how creativity, innovation, and influence emerge and are nurtured.
Natural	Those naturally occurring physical assets in a location, including resources (e.g. minerals, forests, waterways), amenities and natural beauty.
Financial	Access to financial resources to support community capacity building, social and civic entrepreneurship.
Political	Access to power, organizations, connection to resources and power brokers. Ability of people to find their own voices and contribute to community well-being.
Human	Skills and abilities of people, including access to outside resources and bodies of knowledge to increase understanding and to identify promising practices. Human capital also addresses the capacity to "lead across differences," to focus on assets, to be inclusive and participatory, and to be proactive in shaping the future of the community or group.
Built	The physical infrastructure that supports the other community capitals (roads, buildings, services etc.).

3.2.1 Community Description

The community of Kakisa, located in the South Slave region of NWT, is home to the Ka'a'gee Tu First Nation (KTFN). This small Dene community of approximately 50 people is accessible year-round by the Mackenzie Highway and is located between two larger administrative centres, Hay River (120 km) and Fort Simpson (320 km). Kakisa is approximately 370 km from

Yellowknife, the capital of the territory (Figure 3). The KTFN's traditional territory occupies approximately 10,000 square kilometers within the Taiga Plains ecozone, which is comprised of patches of boreal forest intermixed with peat plateaus and wetlands. The area also includes two large lakes, Kakisa and Tathlina, which are connected by a series of rivers to the Mackenzie River. The community uses the area for a wide variety of harvesting purposes, including hunting, fishing, gathering and trapping. As such, the community maintains strong traditions and ties to the land and most residents rely on country foods as a crucial component of their diets with 94.4% of the community having obtained most or all (>50%) of their meat through hunting or fishing (Northwest Territories Bureau of Statistics 2013). The community's most important food source is moose, but other large animals, such as woodland caribou, are harvested as opportunities arise. The lands around Kakisa are also a migratory stop for many species of waterfowl, which are typically hunted in the spring. Fish, is also an important food source for the community, both for personal use and through a small commercial fishery that generates income for several community members.

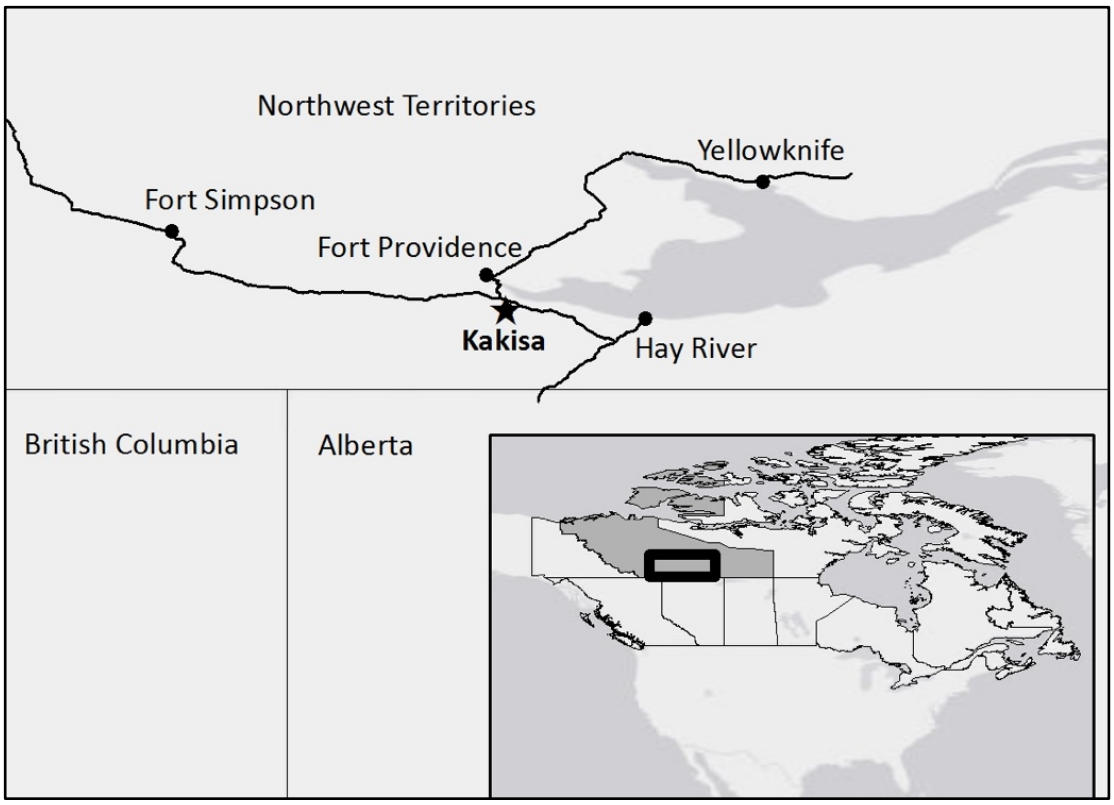

Figure 3. Location of Kakisa, NT (Other communities and roads shown).

As the smallest community in the territory, Kakisa has limited access to infrastructure and services and therefore must depend on resources in nearby communities, increasing costs and time commitments due to travel. Even though Kakisa has year-round road access, adequate alternatives to traditional foods are not always immediately available or are not easily accessible; the closest store is 120 km away and food options there are limited and expensive. No infrastructure for drinking water or wastewater exists in the community, so services from Hay River are required at a cost to the community. The small size of the community also limits economic opportunities for community members. Employment through the Band office (the official community administration), local construction jobs, or through the commercial fishery provides income for some, while others find employment outside of the community. The closest nurse's station is in Ft. Providence, roughly a one-hour drive away. The community has a small

school (K-12), and the Band office and new community hall hosts community gatherings. Development pressures are also an issue for the community, with oil and gas extraction occurring in the Cameron Hills area (located to the south of Tathlina Lake) and proposed forest management and wood pellet production in other areas of their traditional lands. The community is concerned about the impacts of these developments, and others, on the health of the land. As there is currently no land claim settlement in place in the region, the community has limited ways it can have a say in, and protect, their land. One option that the KTFN has been pursuing for years is obtaining protected areas status for their traditional lands. A completed protected area agreement would ensure the land is managed to conserve biodiversity and ecosystems, establish a land management authority, and protect traditional land uses (NWT Protectes Area Strategy Advisory Committee 1999).

3.3 Methods

One of the most important features of this research is how it was driven by the community. The community of Kakisa, through the Band Council and the community's Environmental Coordinator, reached out to researchers through a mutual connection (Ecology North, an environmental non-governmental organization (NGO)) in the NWT, to have this work done as the community was concerned about the impact that climate change was having on their ability to harvest traditional foods from the land. Working through Ecology North, which has developed social capital in communities throughout the NWT, a successful grant application was developed with the aims of addressing the issues of food security and climate change as proposed by the community.

All organizations involved (community, NGO, and academic institution) formed the research team and were able to contribute their expertise to the project, guided by the interests of the community. From the beginning the community directly influenced project goals, methods, and deliverables as an active partner. The goal of the research was to create a food security action plan for the community that featured concrete steps and projects to ensure food security for future generations.

The basis of this research approach borrows from other studies that have conducted vulnerability and health studies in northern communities (Ford and Smit 2004, Parlee et al. 2007). This Participatory Action Research (PAR) approach ensures the research is community-driven and that it responds both to the practical concerns of the community and furthers the goals of social science through the active collaboration of researcher and participant in co-learning (Gilmore et al. 1986). With origins in community empowerment, social action and community health and development (Wallerstein and Bernstein 1994, McTaggart 1999, Altrichter et al. 2002), PAR strives to achieve community-driven/defined social change and transformation (McTaggart 1999). PAR methodologies have been used in building food systems across Canada (Blay-Palmer et al. 2013), including Indigenous communities (Skinner et al. 2013, Stroink and Nelson 2013). Consistent with other work in the North, which utilizes Community Based Research (CBR) approaches (Berkes and Jolly, 2001; Pearce et al., 2009; McGregor, Bayha and Simmons, 2010; Armitage et al., 2011; Tondu et al., 2014), research was conducted alongside representatives of the community, observing – but also contributing to – their activities. Through building trust and open and transparent communications these partnerships and collaborations directly benefit the community (Angell and Parkins 2010, Tondu et al. 2014).

The PAR methodology used here involves fostering as much opportunity for community engagement and participation as possible (Minkler and Wallerstein 2011). The use of community events where food was provided alongside displays of maps, historical aerial photos, and graphs showing environmental changes over time (such as temperature, precipitation etc.), fostered such participation (Wolfe et al. 2011). An introductory workshop was held in August 2014 at the Band office in the community. Events like this allow researchers to engage in informal conversations about the content of the visual material with community members and listen to the stories and concerns of individuals. The interactions allowed researchers to gain insights into community priorities and were an opportunity for researchers to interact with community members and begin to build familiarity and trust. This initial event helped to establish research questions at the intersection of climate change and access to traditional food that are important to communities.

During a one-week period in November of 2014, researchers returned to the community for more meetings and to conduct interviews. A community meeting was held with prospective participants to familiarize them with the research objectives, methods, and to answer any questions regarding the project. As this was the first time participating in an interview for many community members, the researchers ensured that they were made aware of the process of informed consent, and the research was made flexible to accommodate their needs and preferences. This included the timing and location of the interviews. In all, 21 community members were interviewed, encompassing almost half of the community. Such high engagement was made possible by the community's Environmental Coordinator, who spent time talking to

and recruiting community members. Participants who were able to speak to changes on the land, including Elders, harvesters, and others, were selectively sampled with the help of community partners and invited to participate. Each interview took approximately one hour and was conducted in the language of their preference (South Slavey or English). For all interviews conducted in Slavey, an interpreter was used to consecutively translate questions and answers. Interviews were mostly conducted in the Band Council offices, but some were conducted in the homes of some residents if this was their preference. Interviews were semi-structured around open-ended questions so there was enough flexibility to explore more detail based on specific experiences and expertise of each participant (Hay 2000). Questions asked during interviews ranged from a community definition of health, links between health and traditional foods, to how changes on the land are impacting health and access to traditional food. Most importantly, participants were asked what community-based solutions they would like to see to address some of the vulnerabilities identified during these conversations. Questions were modified to suit the participant. For example, Elders were asked to tell stories about their experiences on the land from the past, whereas current land users were asked questions more relevant to present experiences and recent environmental changes (for example, what they see in their landscape and how it has changed over the past few years). All interviews were digitally recorded and participants were reimbursed for their time.

Audio recordings were transcribed verbatim and researchers read through all of the data files to gain a full understanding of the contents of the interviews. A general discussion amongst the research team followed to help identify themes and coding structure (Mays and Pope 1995, Bradley et al. 2007). Resulting data were organized according to themes and assembled in a

results document, which was shared and discussed with a community representative. Data verification was done by giving community members the opportunity to review transcripts and approve quotations before any information was made public. Respondents had the opportunity to either remain anonymous or associate their name with their quotations. A results workshop was conducted in February 2015 to report the preliminary findings of the study back to the community. This workshop allowed individuals to comment on the findings prior to the finalization of reports but also for a discussion on "Next Steps" to determine what actions the community wants to take to address some of the findings. Essentially, the community was describing initiatives they wanted to undertake to build a more resilient food system. This discussion allowed for the formation of a work plan for the community and set priorities for future work. This was a part of the iterative process that builds PAR as well as trust. Final results were shared with community members through plain language documents and disseminated by the community's Environmental Coordinator. This research approach and methodology was approved by the Research Ethics Board of Wilfrid Laurier University and through the Aurora Research Institute, the research licensing organization for the NWT.

One of the innovative elements of the methodology used here is the partnership and personal relationships built with the community's Environmental Coordinator. This individual has been involved in environmental monitoring projects through government departments and non-governmental organizations, and has coordinated field sampling for fish, water and wildlife monitoring with government and university researchers from WLU. As such, the Environmental Coordinator has a high capacity to conduct research and was adept at providing logistical support for this project, both of which were key to its success. Of most benefit to the project was the

social capital and connections this person has in the small community which allowed for easy communication and connections to community members and local decision makers (Chief and Band Council). Their affinity for social networking and text messaging led to increased and timely communication and interaction in the community, which allowed the project to proceed at a more rapid pace, especially when dealing with last minute logistical challenges and accommodating community needs. What emerged as a powerful driver behind the research and subsequent follow up projects was their personal drive to conduct work that made a positive impact in the community. This drive not only enabled them to champion the research, but pushed much of the research from participatory and collaborative to Action Research.

This relationship helped to foster research links outside of the community. For example, the Environmental Coordinator attended meetings at the university in Waterloo, Ontario, with research partners from around the globe, and was able to help shape further grant applications and collaborations. The positionality of the Environmental Coordinator made a significant contribution to the overall project and speaks to the importance of building capacity and empowering communities, and the role of local leaders to be active members of the research team and to enhance participation of community members. Another key element was the partnership between an academic institution, the community, a territorial non-governmental organization, and government agencies to conduct this research. Part of building resilience and fostering food system development is to build social capital by fostering connections and networks within (bonding social capital) as well as outside of (bridging social capital) the community (Blay-Palmer et al. 2015). By building a strong network of organizations, where each partner brought their own expertise to the research team, the group was able to leverage

other networks and funding, and bring diverse experience in similar or related work to the community (Putnam 1995, Emery and Flora 2006). This became important after the initial research was conducted and community-defined projects were prioritized. As funding sources were identified, different partners that were more suited for specific grants were put forward as the proponent with the other groups offering letters of support and assistance in writing. The community had final approval on all grants moving forward. This partnership leveraged the capacity of other groups to target and obtain funding sources for the community in a way that benefited all groups involved.

3.4 Results and Discussion

The members of the Ka'a'gee Tu First Nation have observed changes to the land, animals and water around them that they attribute to the impacts of climate change and are concerned that these changes are impacting food security in the community. Interviews with community members revealed that the importance of the land, social connections, and culture are the basis of the community's food system and their connection to place. However, issues, concerns, and barriers to food security due to the impacts of climate change and other societal factors were identified. Participants also shared ways that they are currently adapting to the changes om the land, but more importantly, shared ideas for how the community can strengthen their food system to be more resilient to the impacts of climate change. This section is therefore organized into three subsections: describing the community food system, impacts of climate change, and building capitals for a more sustainable food system.

3.4.1 Describing the Community Food System

Through preliminary project scoping and engagement events it was apparent that the preferred food system for the community relied on traditional food. What emerged during interviews and discussions was a more detailed understanding of the importance of the land and traditional foods to the community's health and well-being. Community members spoke about the importance of being on the land and eating country foods as the foundation of being healthy. The link between a healthy ecosystem, clean water, and a healthy community emerged, as one informant explained,

> "So I guess the health depends on the animals. My grandfather used to talk about things like that. He said we have always been rich in animals and their fur and moose and stuff like that. And our health depends on the health of the animals, the fish and that kind of stuff."
> ~Lloyd Chicot

Therefore, in terms of community health and well-being, as well as the community's food system, the land, water, and traditional foods, which are important components of natural capital, play crucial roles. Another important component of the food system is the ability to access natural capital through cultural capital, which relies on learning skills and Traditional Knowledge that is passed through generations. Food sharing, a common practice in Indigenous communities, and part of the social economy, ensures that all community members have access to country foods, particularly those in need (McMillan and Parlee 2013, Natcher 2015). Overall, being on the land and eating country foods and practicing traditional activities, including the

sharing of country food, is important to community members in Kakisa and was seen as a main strength of the community.

> "The traditional values of our people. We still follow the traditional lifestyle. People are very...good and polite, and we help one another. Helping one another in the community. We share with each other. So you could say that it is like one big family."
> ~Margaret Leishman

As such, natural, cultural and social capitals form the basis of the food system in Kakisa. However, like other communities in the North, the food system has changed over recent years. Accessing natural capital by hunting, fishing, and gathering now requires more financial capital as money is needed to purchase gas, gear, and supplies. To build this financial capital, community members need access to jobs, something not readily available in this small community, so they need to travel to other communities for work. However, community members spoke about how working leads to less time available for on-the-land activities and they therefore rely on sharing networks and/or store-bought food more often. Store-bought food was also discussed as being a necessary part of the food system, but was perceived by many to be unhealthy compared to country foods and more expensive, as has been observed in other studies (Lambden et al. 2007, Wesche and Chan 2010).

> "Being able to eat traditional food I think is a good way of being in good health. You go to the store and buy hamburger and eat hamburger and eat processed chicken and stuff

like that. You are putting garbage in your body when you can just go out on the land and go get it."

~Anonymous community member

With the nearest grocery store located roughly an hour away, the time and financial capital needed to travel to the store, let alone the cost of food, was a concern. For many, the transition away from traditional food has resulted in greater food insecurity, particularly amongst those who are not able to harvest foods nor have family members able to share enough with them.

"Compared to way back, we had plenty food and today it's not [like that]. Today we purchase our food and it's very expensive"

~Community Elder

Some harvesters, particularly those with young families, find it difficult to find the balance between the need to work in the waged economy and being on the land. One participant shared their experience:

"Actually it really is [hard to find a balance], especially when I am working now. But I would like to go back on the land, but there is not much income, especially with trapping. I used to do quite a bit of that. But there is just not much in it. It is a lot of work, and everything costs money now."

~George Simba

Although maintaining on-the-land traditions and being a close-knit community were mentioned as strengths of the community, there is a general concern that those strengths may be at risk in the future. Many community members were concerned that youth, in particular, are not as interested in traditional foods and activities, and more importantly, do not speak Slavey. Youth, as well as many of the younger community members speak only English and Elders mainly Slavey; therefore, language is seen as a major barrier preventing interactions between youth and Elders. This could impact the long-term access to cultural capital if Traditional Knowledge and skills are not passed down to the youth who will be providing food for the community in the future. Although the community has held many on-the-land camps for youth and community members in the past and wishes to continue to do so, it was noted that while there are opportunities to do more on-the-land activities and community hunts, there are issues with low participation due to time commitments such as work, or low interest. Low participation in an already small population is a challenge. As the community is active in meetings and discussion to protect their lands and contribute to regional initiatives it is taxing on the few individuals that represent the Band and their interests. This small community is being asked to contribute to many initiatives and discussions that will shape the future of the lands and their food system.

Table 2. Summary of community capital in the food system of Kakisa as determined though community interviews, showing key elements that contribute to (+) or degrade (-) capitals.

Capital	Attribute
Social	(+) Strong social economy (food sharing) (+) Small, close-knit community (bonding social capital) (+) Experience with research networks outside of community (bridging social capital) (-) Some issues with degradation of bonding social capital in the community. (-) People leave community for education and jobs
Cultural	(+) Most community members maintain traditional practices and activities and a strong connection to the land (-) Limited time available to take part in traditional activities (for some) (-) Language as barrier to transfer of Traditional Knowledge (-) Some youth not as engaged in traditional foods and activities
Natural	(+) Abundant sources of country food (+) Abundant access to clean water (-) Concerns of impacts of development on the health of the land
Financial	(+) Access to community funding and government grants (+) Small commercial fishery (-) Limited availability of jobs in community (-) High cost of living (food, gas, and supplies)
Political	(+) Active local government (+) Pending protected area designation (-) Limited decision-making ability in terms of control of lands
Human	(+) Engaged community (active in training opportunities) (-) Small population (-) Time and effort needed to travel to other communities for store-bought goods.
Built	(+) All-weather road access (+) Local school (+) Community hall and culture camp (-) Limited infrastructure (health, water, etc.) (-) No store

Using information from the interviews as well as through preliminary project scoping and discussion with community members, an outline of the community food system in terms of community capitals was created (Table 2). Each key point determined through the research had either a positive or negative influence on each capital. For example, being a small, close knit community where food sharing is common practice indicates the presence of strong bonding social capital, connections between community members, that is an asset to the food system.

However, issues of low participation and engagement as well as some community members leaving in pursuit of jobs or training can decrease social capital. Cultural capital is maintained through practicing traditional ways of life and passing that knowledge down to the youth, and although the community prides itself on living the traditional way of life, barriers such as loss of language, participation, and time commitments threaten that capital. The current food system, which the community depends on for health and well-being, is being strained from the depletion of too many capitals at once. Now, and maybe most importantly, the pressures of climate change on community natural capital, as detailed below, will add more pressure on the food system.

3.4.2 Impacts of Climate Change on the Food System

Climate change is having an impact on the lands, waters, and animals around Kakisa. Through interviews and engagement, community members shared stories and experiences about the changes witnessed on the land and provided context as to how the broader global changes have impacted their community and their food system. These changes have caused them to become worried about the health of the land, water, and animals that they depend on as part of their culture and also for food. In general, the community has noticed a warmer trend in recent years, not only in the summer months, but also in the winter. Elders recounted stories of times in the past where the cold temperatures would crack trees, but it had not been that cold for quite some time. These changes in temperature are having impacts on the community's ability to harvest country foods. More variability in weather is making it harder to predict conditions and requires people to wait longer for lakes and routes to freeze and adjust to earlier melt in the spring. Storing and preparing food while on the land is more problematic as well, bringing up issues of food safety. As one participant described it,

> "The weather is really warm most years, like September when we went goose hunting. We had some moose meat hanging out drying and smoking, and those spoiled because the weather was really warm at the end of September and usually it is cold enough so we just let the meat hang."
>
> ~George Simba

Changes on the landscape due to permafrost thaw results in land subsidence, conversion of forest to muskeg, and changes in water resources, and have significantly affected the lands around the region (Quinton et al. 2011, Williams et al. 2013, Baltzer et al. 2014, Coleman et al. 2015). This landscape change, and more importantly changes in water and ice conditions makes travel more difficult and less safe. Although changes in landscape have been witnessed by community members, their concerns were more focused on changes in water. Waterways are an important method of accessing the land, vital to ecosystem health and is a central part of the definition of place (Fresque-Baxter 2013). These changes are experienced more in the winter months when the land is more accessible and where observations and concerns are based around what does or does not freeze as it used to. For example, there is an increase in the risk of skidoos becoming stuck in unfrozen muskeg or falling through the ice because of changing conditions. With these changes, the need to be more cautious on the land was identified in the interviews and more broadly in the literature (Ford et al. 2008, Pearce et al. 2012). This requires harvesters to know what to watch out for and take time to check conditions, such as ice thickness and patches of "candle" ice, described as when ice looks like swiss cheese, so that it may be dangerous to cross.

Lack of rain, and how dry the past few years have been was also a common theme during discussions. The impacts of the dry conditions on food sources, such as berries as well as the overall health of the lakes and waterways were mentioned as major concerns.

> "There's no berries. The weather in the summer is too hot and the berries dry up fast."
> ~ Community Member

Lower water levels and an increase in water temperature in both lakes have been observed, particularly in the past few years. Water levels have been so low in Tathlina Lake that the 2014 fall moose hunt was called off because the plane was unable to land in the shallow waters. Not being able to conduct this hunt worried several community members for many reasons. It is an opportunity for many community members to be on the land together, fostering social capital, and intergenerational knowledge transfer, and to build cultural capital. It is also an opportunity to fill people's freezers with meat for the winter. The fall hunt is an important activity to support food security for the entire community as moose meat is brought back and shared. In addition, low lake levels, particularly in the shallow Tathlina Lake, caused some community members to be concerned about the long-term health of the fish population.

> "We are worried about the lake, especially the lake to the south, Tathlina. There it is pretty shallow. It is probably three feet or four feet. If it gets any shallower, I am not sure about the fish. I worry about that more than I do with this lake (Kakisa) because this lake is deeper. If the water drops, there will still be enough for the fish. It is the other lake that

> I worry about. Everyone depends on that lake for fishing. And in winter time, for commercial fishing too".
>
> ~George Simba

Fish are a plentiful source of food, but are an important community staple as they are relied on when other food sources are not available, but also as income through a small commercial fishery. The community has invested in fish processing infrastructure and wishes to see the economic benefits of this investment continue. As such, fish, and therefore the health of the waters in the region, play a vital role in the health of the community's food system, influencing several capitals.

Community members have also noticed changes in animals. New animals have appeared on the land and waters, including pelicans, cougars, and deer, while traditional foods, moose in particular, can be harder to find. The introduction of new species does not necessarily add new food options for the community nor replace another species as has been proposed in other studies (Ford and Smit 2004, Ford et al. 2006b, 2008, Wesche and Chan 2010, Andrachuk and Smit 2012). Here, when speaking of the possibility of harvesting deer to support the community, one Elder and active harvester spoke of reluctance to do so because of the lack experience or Traditional Knowledge of harvesting and preparation methods. Lack of cultural background about these new species limits their use in the community's food system. As for other changes in animal availability, community members are noticing timing of spawning runs and animal migrations are different than they used to be. This results in missing opportunities to harvests species at times and locations as they were used to doing in the past. There is a decline in the

health of some animals, with more frequent observations of ticks on moose and parasites in fish. There is concern that the land is changing so rapidly that Traditional Knowledge can no longer predict or explain what the community sees on the land.

Table 3. Impacts of climate change on community capitals related to traditional food access.

Capital	Climate Change Impacts
Social	(-) Limited ability to be on land as a group (low lake levels cancelling community hunts)
Cultural	(-) Traditional Knowledge not reliable to predict conditions (-) Limited opportunity to pass on Traditional Knowledge (low lake levels cancelling community hunts) (-) Limited intergenerational transfer of knowledge increasing risk to harvesters
Natural	(-) Warmer temperatures impacting food preparation and storage (-) Variable weather makes it harder to predict conditions (-) Low water levels impacting lakes (travel, potentially fish populations) (-) Drought impacting availability of berries (-) Health of food species being impacted (+/-) New species present (-) Changes in animal availability and timing of migration (-) Changes to land make travel more difficult
Financial	(-) More resources needed to travel further in search of food (gas and supplies) (-) Resources needed to maintain access to land (clear trails)
Political	(-) Decreased ability to travel and monitor lands
Human	(-) Increased safety risks while traveling on land (-) More time and effort needed to obtain traditional foods (-) Stress due to increased uncertainty
Built	(-) Trails and cabins on the land need more maintenance

The impacts that climate change is having on the food system, as described by community members through interviews, are summarized in Table 3 in terms of community capitals. These impacts, with the exception perhaps of the introduction of new species, were perceived as being negative by the community. Although the main impact of climate change is on natural capital, repercussions are felt in the other capitals that make up the food system. For example, changing

conditions on the landscape impacts human capital due to more risk to the harvester and time needed to remain safe. Financial capital is reduced because more time, gas, and other supplies are needed to travel farther to avoid hazards and through increase risk to harvesting equipment. These changes on the land can also impact both social and cultural capital if community members cannot access the land or harvest the traditional foods that are part of the culture. It should also be noted that the impacts of climate change were identified by participants as having negative effects on the land and food system. Therefore, a food system that was already being compromised due to the depletion of many capitals (see Table 2) is further stressed by the impacts of climate change. For example, if climate change creates further challenges or barriers to accessing the land, fewer opportunities for long-term replenishment of cultural capital through community hunting camps will be available.

3.4.3 Building Capital for a More Resilient Food System

Allocating existing capitals allows communities to cope with or adapt to the impacts of climate change on access to and availability of traditional food sources. However, with the threat of climate change and other factors limiting the creation and maintenance of some capitals, there is the need to build a food system that is more resilient to these stressors. Enabling the community to continually adapt over time to future social and ecological changes by building on community strengths, values and vision was an important part of this research (Berkes and Ross 2013, Ross and Berkes 2014). Resilience can be more than just maintaining a system as it recovers from a disturbance, it can be seen as creating opportunities for transformation to more desirable endpoints (Davoudi et al. 2013). As part of the PAR methodology utilized in this research,

participants were asked questions about how to address the impacts of climate change on their food system and to improve access to food for the community.

With all the changes impacting the land, ensuring the safety of harvesters was important to many community members. Being safe on the land now requires more allocation of community capitals. The community informally uses the "buddy system", or going out with a group of harvesters, when on the land. This requires using more financial capital (for additional gas and supplies), as well as relying on human and social capitals. However, harvesters also require proper skills and training to be safe and survive on the land, and to be aware of conditions. Accessing cultural capitals, through Traditional Knowledge is therefore key to developing these skills. Many participants agreed that learning more on-the-land skills is important for younger harvesters to be safe and survive on the land in case of emergencies where they may need to stay longer on the land than planned. However, creating opportunities for that to happen can be limited by financial capital. As one Elder explained:

> "To be on the land. That means we need money to make it happen so that we can be on the land and have the Elders to teach the kids. It is also creating opportunities for the Elders to fill their roles as teachers. Elders are always the teachers."
> ~Community Elder

Another Elder commented that although community hunts are a good way of being on the land together there is, generally, low participation by some of the youth.

> “But a lot of small kids they don't like traveling in the Bush. It's too much work for them I think. The ones that like to do something, they're good. I don't think you'll be able to teach them what they don't like. “
>
> ~Community Elder

Ultimately, this disconnect between youth and Elders may have been caused through the impacts of residential schools, where those directly impacted were not able to transfer their knowledge on to their children, who in turn, do not pass it to their children.

> “A prime example is residential school people. It has affected all of our generations. Because of that, if I went into the school and talked to them for half an hour, they wouldn't know what I am talking about. So, parents need to be taught also to re-learn. And for the Elders to be given their roles again and to re-earn their roles again.”
>
> ~Community Elder

Bringing the community back together, and building bonding social capital, therefore, appears to be a key element in supporting a more sustainable food system and helping the community adapt to climate change as it is key to knowledge transfer. The community identified strengthening social capital over the long-term as a priority, and the Band Council has actively been trying to address this issue over the past several years. The community has held many on-the-land camps in the past allowing youth to gain skills through experience while strengthening social and cultural ties in the community. Language programming was a priority already identified by the Band Council. The Council continues to pursue and develop language learning as a key to

understanding and preserving Traditional Knowledge and the cultural identity of the community. Encouraging on-the-land activities has been cited as a key adaptation strategy in other studies (Ford et al. 2006a, Pearce et al. 2012, Cunsolo-Willox et al. 2012). The community wants to continue to pursue other opportunities to build social capital as well and want to see all future projects and research incorporate on-the-land experiences and foster youth and Elder relationships whenever possible. This also fosters truly engaged PAR as the community continues to define the scope and objectives of future research.

In Kakisa, the health of the land and the health of the community is closely tied together. Community members spoke of the importance of doing what they could to help take care of the land and strongly identified with stewardship and monitoring programs as priorities for the community.

> "If you take care of the land and the animals, then the land will take care of you."
> ~Terry Simba

One common practice amongst harvesters was taking pictures of what they saw on the land. In fact, during interviews, many harvesters took out their smartphones and showed the research team pictures from their trips on the land. Others mentioned numerous pictures they had taken of changes they have seen on the land. These photos may include conditions and hazards, animal sightings or other interesting occurrences. Through taking pictures and sharing information from the land the community is already engaged in an informal monitoring of change. Although this information was primarily shared through kin relationships, it was agreed that more information

should be shared throughout the community as an opportunity to build social capital. As one Elder explained:

> "We used to share stories all of the time when the hunters and fisher people go out and the trappers. When they come back they used to all come together. The men especially. And they would share their information. You know, if the fur was good, and what area was plentiful. My dad was really good at that and he used to organize those talks all the time. Today people come back here sometime after hunting, and they go into their house and you don't see them again. We need to learn how to share these again."
> ~Community Elder

Information, knowledge, and skills are resources, shared in similar ways to traditional foods in communities, flowing through kin relationships (Harder and Wenzel 2012). Active harvesters commented on how they would often share information with family members, but not with the broader community, as used to be the case. The interest in sharing photos and capturing conditions and observations on the land illustrates how investments in financial and built capital (technologies such as cellphone networks, internet, phones and cameras) can help build community capitals and foster innovation and adaptations in the community. Initial discussions with harvesters as well as other community members during the 'Results Workshop' indicated that the community was interested in further developing a monitoring initiative based on the photos and information community members were already collecting. Community members were interested in learning more about mapping, using GPS, and contributing to an online database accessible by community members. This initiative may help to build political capital as

the database of images and observations can be used to enhance decision making, at numerous levels, contribute to ongoing research in the region, and promote stewardship of the land (Bennett and Lantz 2014, Gill et al. 2014b).

Another initiative that the community felt was important to take care of the land was through waste management. Being clean and free of garbage was cited as a major strength in the community.

> "As individuals, we need to take care of the land. A big thing with the land is how well you take care of it and how you take care of your garbage."
> ~Anita Chicot

Participants identified numerous issues with waste in the community, citing lack of appropriate recycling infrastructure, concern about pollution at the community landfill, desire to keep the community clean, and to do their part to take care of the land. The ties between food availability and waste management also emerged, as the community feels that their landfill is a source of contamination for the land, and therefore animals that they find near the landfill may not be suitable for consumption. So, diverting waste from the local landfill could increase the availability of food. However, waste diversion is challenging in the region as the nearest recycling collection facilities are located in Yellowknife. Although some community members admitted to taking their recycling to Yellowknife when they travel there on business, it is not a sustainable solution. The community is interested in exploring other options, such as working

with other communities to create waste management solutions as well as composting organic wastes.

Building a more sustainable community food system by growing food was an adaptation that each community member discussed during interviews. Everyone had positive responses to the idea of either community gardens or individual garden plots, and many interviewees shared positive stories about past gardening experiences in Kakisa. Many community members saw the benefits of gardening to be eating healthier food that they could grow themselves, and would be a less expensive alternative to food from the store. This may also lead to less travel to Hay River for groceries and a lower burden on financial capital allowing for more resources to be allocated to being on the land. Government programs in the NWT are available to pay for the installation of gardens and related infrastructure, making gardens an option for those who are interested. However, community members also identified some key barriers to growing their own food, specifically, a lack of education and recent experience around gardening, and, most importantly lack of time to tend the gardens.

> "If people could come and make a garden and show us how to do it. We could do it, we could weed and water it and stuff like that. I don't know who to ask. Some of them they make a box and they make a garden in there. That would work. It would be nice to have something to grow your own vegetables. So you wouldn't have to go all the way to Hay River for that stuff."
>
> ~Sarah Chicot, Elder

Building human capital and skills around gardening are needed. This will, for the most part, be a completely new resource to add to the community as Dene culture has had little experience with growing food. The literature does contain some evidence of gardening in Indigenous communities in the past in the region (Helm 2002, Loring and Gerlach 2010) and there have been several attempts at gardening in Kakisa in the past, mostly through Band, school or government involvement. These gardens ultimately failed because either the community champion moved away or a garden was built under the assumption that community members had the skills needed to care for and utilize it. Lessons from these past failures need to be learned. Building capacity and fostering community engagement are key to supporting communities interested in growing food. Fostering partnerships with local resources such as the Northern Farm Training Institute (NFTI) located in Hay River can provide the training and support key to community success. This challenge is not unique to Kakisa. Human and social capitals are needed for many communities in the NWT to support small-scale garden plots and potentially scale-up existing gardens towards larger scale food production (Douglas et al. 2014, GWNT 2015).

Building a more resilient food system and implementing initiatives proposed by community members will require the creation of new and the enhancement of existing capitals. Some capitals can be developed through initiatives already implemented in the community, such as promoting safety and training of young harvesters through mentorship. Or adding new skills and capacity though training. A summary of the capitals that are required or could be developed through existing and proposed adaptations and initiatives is presented in Table 4. However, as noted, developing programs to foster each capital takes both time and financial capital. The

community wants to foster change through programs that engage and involve the community, particularly youth. As such, some of these initiatives have already begun to be developed through partnerships with the community and other organizations. Gardens, for example, were installed in the summer of 2015, planted in part by the school and supported by hands-on training for community members by NFTI. It is hoped that community engagement and involvement will help to spiral up capitals, where building one capital leads to the development of others, and this in turn can lead to positive changes in the community (Emery and Flora 2006).

Table 4. Community capitals being developed or required to foster resilience in community food system.

Capital	Adaptations
Social	Increase community engagement Use of "buddy system" and community watch to keep harvesters safe More frequent community hunts and time together on the land Increase communications amongst harvesters to report conditions on the land
Cultural	Language programming "Buddy system" creates opportunity for mentorship of youth Promote on-the-land camps and community events when possible
Natural	Recycling to increase stewardship Monitoring land for impacts of climate change and development Participate in environmental research Contribute to local and regional land protection initiatives
Financial	Resources needed to fund community-defined programs
Political	Monitoring lands Participate in regional discussion for land protection
Human	Skills and training needed for initiatives (gardening, mapping, etc.)
Built	Infrastructure and tools required programs and initiatives (gardens, etc.)

3.5 Conclusion

Climate change is having an adverse impact on the already strained community food systems in the North. These impacts are affecting natural capital through changes witnessed in the land, water, and animals that form the basis of the food system and affect health and well-being in communities. Through the lens of the CCF, this research highlights the interconnections

of community capitals and how impacts to natural capital are having broader effects within the community. This research details a PAR approach to climate change adaptation where community members were able to determine their own goals and priorities, and work with project partners to identify plans and next steps to help build more resilient food systems. By identifying transformative projects that are important to enhancing food availability, the community is actively defining their food system. These projects involve key themes of reconnecting to the land, taking care of the land, and growing food, but require the addition of human, financial, and social capitals to enhance capacity, skills, and engagement within the community. Initiatives such as these will take time to implement, which requires a long-term partnership between the community and researcher to build capitals and capacity, reflective of the PAR process. All of the potential programs determined by community members rely on building or maintaining certain capitals. Human capital is required in the form of education, training, and capacity building within the community to learn new skills to implement these programs. Financial capital is needed for these projects and, in some cases, is (or can be) available, but accessing that capital can be difficult if necessary human capital is limited. (e.g. grant writing). The community also strives to have more political capital, as well as to have more say and protection of their lands and natural capitals, which are the basis of their food system. However, political capital is limited by human capital as only a few community members are available to represent the community at meetings. But by using the political capital available and by building social capital through networks that extend outside of the community (through research and monitoring networks or similar initiatives), the community is playing an active role in trying to protect their natural capital. Social capital, either bonding social capital such as community engagement to strengthen ties within the community, or bridging social capital to

create networks outside of the community to bring in new knowledge and skills, will be key elements of successful implementation.

The CCF offers a valuable lens for the issues of climate change and food security that are impacting Indigenous communities in the NWT. The capitals approach better describes the complexities of the food system that is both the product of tradition, culture, and the close relationship to the land as well as unique socioeconomic and political pressures that continue to shape communities. The CCF puts the community first and offers a place-based analysis for food system issues. It allows us to see past issues of food and include other issues that impact the community's well-being. It also offers a starting point to better integrate the unique food systems of the North into the broader context of food system literature. This can further act as a bridge to bring in new knowledge where communities in the North can learn a great deal from food system studies from around the world. It may be, however, that Kakisa does not be fully represent what is being experienced in other communities in the NWT or elsewhere. Due to its small size the community has high amounts of social capital, mainly through kin relationships. Larger communities may have a more complex social structure as well as other place-based circumstances that make their food system different. Further work in larger communities would offer a valuable addition to the emerging dialog of food systems in the North. However, communities like Kakisa can also offer lessons for communities around the globe, particularly those communities adapting their own food systems in the face of climate change.

4 Learning from the Past to Deal with the Future: Building community capitals through knowledge to ensure food security in the Tsá Tué Biosphere Reserve (Northwest Territories, Canada)

Abstract

The community of Délı̨nę, located in the UNESCO Tsá Tué Biosphere Reserve, is experiencing the impacts of climate change on the lands surrounding Great Bear Lake, in Canada's Northwest Territories. These impacts are limiting the community's ability to access the land to support their food system. This article details a participatory action research approach, driven by the community, to develop a community food security action plan to deal with the uncertainties of a changing climate on the food system. The Community Capitals Framework (CCF) is used to describe the complex nature of the community's food system in terms of available or depleting capitals, as well as how the impacts of climate change affect these capitals, and the needs identified by the community to aid in adaptation and foster a more resilient food system. For Délı̨nę, the theme of self-sufficiency emerged out of concerns that climate change is negatively impacting supplies from the south and that building and maintaining both social and cultural capital are key to achieving food security in an uncertain future. Learning from the past and sharing Traditional Knowledge was a key element of food security planning. However, other types of knowledge, such as research and monitoring of the health of the land, and building capacity of the community through training, were important aspects of adaptation planning in the community. This knowledge, in its many forms, may assist the community in determining its own direction for achieving food security, and offers a glimpse into food sovereignty in Canada's North.

4.1 Introduction

Biosphere Reserves are areas with unique ecological and cultural heritage designated by United Nations Educational, Scientific and Cultural Organization (UNESCO). Moreover, they show a commitment by local organizations to sustainably manage the resources in these areas and showcase these living laboratories to the world. Designated in as the first Indigenous-led Biosphere Reserve in the world, the Tsá Tué Biosphere Reserve occupies approximately 121,595 km^2 of the Great Bear Lake watershed in Sahtú Region of the NWT and is home to the community of Délįnę (Figure 4). The lake, the largest lake entirely within Canada and eighth largest in the world, remains relatively pristine due to its remote location and lack of development in the region. Located between three Ecozones, Southern Arctic, Taiga Plains and Taiga Shield, the area has a diverse and unique landscape, geology and ecology. However, this region, as with much of the northern regions of Canada is under threat from the impacts of climate change.

During the past 50 years, Canada's northern region has seen an increase in temperature of 1.5–2.7°C, roughly 4 to 5 times greater than the global average (Woo et al. 2007, Price et al. 2013, IPCC 2014). Climate change impacts such as decreased sea ice thickness, permafrost thaw, changing migratory patterns of animals, and the increased intensity and frequency of weather events are affecting the access to and availability of traditional food sources, which are the staple of community food systems (Nickels et al. 2006, Ford et al. 2006a, 2008, 2010c, Guyot et al. 2006, Pearce et al. 2009b, Andrachuk and Smit 2012). Indigenous communities have a deep connection to the land and depend on it for their food, health and cultural and spiritual well-

being; they are vulnerable to the impacts of changes to the ecosystem (Smit and Wandel 2006, Costello et al. 2009, Cunsolo-Willox et al. 2012). Issues of climate change have been a concern of the Délı̨nę community, as are issues related to food security and community health and both have become increasingly pressing with the significant decline of the Bluenose East caribou herd (Adamczewski et al. 2012, Boulanger et al. 2014). The community faces the prospect of reduced caribou harvesting and may face other uncertainties due to the impact of climate change such as access and availability of other traditionally harvested species.

However, the impacts of climate change on community food systems need to be put in a broader context of food system transition Indigenous communities have faced due to decades of social, cultural and political changes, on multiple scales (Power 2008, Council of Canadian Academies 2014). As a result, Indigenous food systems in the North, and across the globe, have moved away from traditional diets towards a reliance on food purchased from stores (Kuhnlein and Receveur 1996, Kuhnlein et al. 2004, Damman et al. 2008). Not only has this transition had a negative impact on health (Receveur et al. 1997, Kuhnlein et al. 2004, Kuhnlein and Receveur 2007, Johnson-Down and Egeland 2010, Egeland et al. 2011, Gagne et al. 2012), but the high cost of food from the stores and lack of affordable, nutritious options are major barriers to food security (Lambden et al. 2006, Council of Canadian Academies 2014). This food source is also vulnerable to the impacts of climate change as the reliability of winter roads and infrastructure to supply to stores will be affected (Prowse et al. 2009). Food security, defined broadly as "a condition in which all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996) has emerged as a growing concern in northern communities. Individuals face

multiple, and often complex barriers, to achieving food security, particularly in the North, where rates of food insecurity can range from 24% to 48 - 69% more remote areas, dramatically higher than the national average of 8% (Rosol et al. 2011, Council of Canadian Academies 2014, Tarasuk et al. 2016).

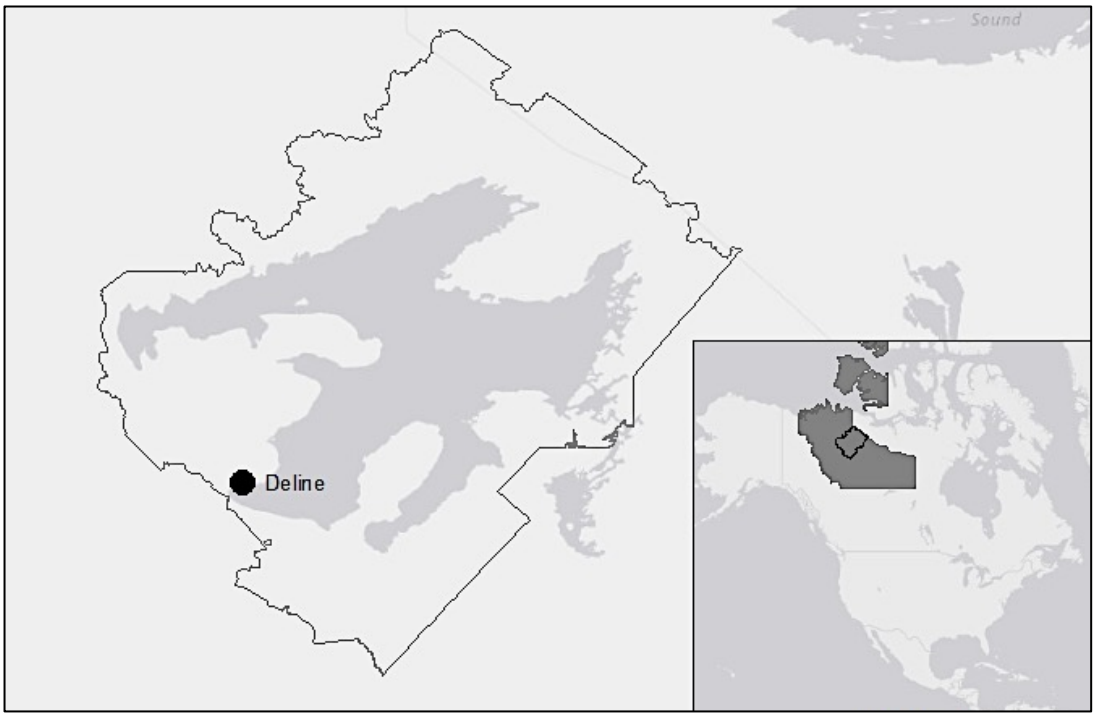

Figure 4. Location of Tsá Tué Biosphere Reserve, which encompasses the watershed of Great Bear Lake, and the community of Délı̨nę, NT.

To better understand the vulnerabilities and issues behind food insecurity in northern communities, there is a need to examine food systems through a different lens, one that accounts for the complexities, uncertainties, but also strengths in the community (Wesche et al. 2016). The Sustainable Livelihoods (SL) is one approach that provides a more holistic and participatory framework to community development and well-being is by examining the capitals and assets people require to make a living (Scoones 2009). SL grew from poverty and development studies

(Chambers 1992, Scoones 1998), but have emerged as a focus of climate change adaptation literature, particularly in developing countries (Connolly-Boutin & Smit, 2016; Nkem et al., 2013). SL approaches have been utilized in Indigenous communities, predominantly in Australia, where issues of development, rights and conservation were examined from a community perspective (Moran et al. 2007, Nikolakis and Grafton 2015). In this research, however, the Community Capital Framework (CCF) is based on the SL approach, is used to define the food system in a remote Indigenous community in the NWT. Developed by Flora et al. (2004), the CCF illustrates the interactions of seven types of capital contained within a community, including: natural, social, cultural, political, built, financial, and human. This approach to describing the food systems of communities in the North complements other emerging definitions of food systems, including complex adaptive systems (Stroink and Nelson 2013) and systems-of-systems approaches (Hipel et al. 2010, Blay-Palmer et al. 2015). A systems approach is also important for addressing issues of resilience, the ability to recover from a shock or stress, that are key to the sustainability in the face of climate change (Gunderson and Holling 2002, Walker et al. 2004, Olsson et al. 2004, Folke 2006).

The SL approach and more specifically, the CCF are appropriate for food systems in the North as Indigenous communities have a diverse set of economies, and therefore capitals, that they can access to maintain their way of life, including the social, traditional and wage-based economies (Usher et al. 2003, Abele 2009, Dombrowski et al. 2013a, Harnum et al. 2014, Simmons et al. 2015). The Dene Way of Life describes the close relationship to the land, being on and living off the land but also includes elements of self-governance, practicing cultural and spiritual traditions the social network and support of families and the community (Bartlett 2005, Parlee et al. 2007,

Harnum et al. 2014, Simmons et al. 2015) – again describing many of the capitals present in the CCF, including natural, cultural, social and political capitals. The addition of financial and built capitals reflect the needs for tools, equipment and infrastructure required to access the land, and support community services including food purchased at the stores (Council of Canadian Academies 2014).

This research details a collaborative Participatory Action Research (PAR) methodology used to explore climate change vulnerability and adaptation strategies for the community of Délı̨nę in the Tsá Tué Biosphere Reserve. Community members are concerned about the impact that climate change is having on their important food sources, including caribou and fish. This concern triggered a broad discussion about climate change, health and well-being, and food security in the community. The research presented in this paper draws on a project, initiated at the invitation of the community, that strives to: 1) understand the role of traditional foods and practices in the community's food system; 2) document changes in availability of traditional foods and threats to food security; and 3) develop food security adaptation strategies and programs to ensure food security for the future. Under a SL approach, climate change is a stressor, but one of many that can impact several systems; and the capacity for people to adapt relies on their ability to access different capitals, which are also impacted by the same systems (Connolly-Boutin and Smit 2016). This approach may help to better understand how climate change is impacting the different capitals of the food system, and how the community allocates capitals to adapt to these impacts. This can not only enable a community to identify the capitals required to build a more sustainable food system, but more generally gather insight into food systems of the North and act as a case study for other communities seeking to adapt their food

systems in the face of climate change.

Community Description

The Tsá Tué Biosphere Reserve is home to the community of Délı̨nę. A small of community of approximately 600 people, the majority of which are Dene, it is the only settlement on Great Bear Lake (Figure 4). The Sahtúot'ine, or Bear Lake Dene enjoy a close relationship with the lake and the surrounding landscape and rely upon it for their health and spiritual well-being. Hunting, fishing, trapping and gathering remain important activities and the basis of the community's food system and livelihood. According to the 2013 census, 92% of households in Délı̨nę consumed meat or fish obtained through hunting and fishing while 57.5% of community members hunted or fished and 15.7% trapped (Northwest Territories Bureau of Statistics 2013). It was also reported that 78.4% of community members were able to converse in their Aboriginal language, one of the highest rates in the territory (Northwest Territories Bureau of Statistics 2013). Délı̨nę, like all communities in the Sahtú region, is remote and accessible only by air, boat, and winter road. Therefore, the majority of supplies, including fuel, food and other materials, are shipped into the community during the window of winter road operation, typically from mid-January to late March. Fresh food stuffs and other necessary supplies are resupplied to the community on a weekly basis through air cargo flights. Délı̨nę does, however, contain a relatively large amount of infrastructure needed to support it. There are two grocery stores, a K-12 school, adult education through the Territorial College, a medical centre, community centre, arena and spiritual centre. Power is generated onsite through a diesel generator. Employment is limited. There are opportunities through the various governance organizations that support the

town, but many people leave the area for employment. Although there is a history of mining, resource exploration and site remediation around the area, the lake is used for tourism through outfitters in Délı̨nę and around the lake, often for trophy fishing or to visit Saoyú-ʔehdacho National Historic Site, operated by Parks Canada.

Politically, Délı̨nę is home to a number of both locally and regionally important decision-making bodies. As the area is subject to the Sahtú Dene and Métis Comprehensive Land Claim Agreement, signed in 1993, beneficiaries hold subsistence harvesting and land rights throughout the region. The Sahtú Secretariat Incorporated (SSI) oversees economic development as part of the agreement, and the Délı̨nę Land Corporation (DLC) and the Délı̨nę ʔehdzo Got'ı̨nę Délı̨nę (Renewable Resources Council, DRRC) were created to ensure these rights and benefits for the community. Local government was facilitated through both the Délı̨nę First Nation (DFN), which was the principal negotiating body with the federal government, and the Charter Community of Délı̨nę oversaw municipal services such as the airport, roads, as well as water, sewage, and garbage services. Now, however, the community is enacting self-government, which amalgamates all the local decision-making bodies, including the DFN, Charter community, DLC and the DRRC, into one governmental organization, the Délı̨nę Got'ine Government, that now oversees the needs of the community. This self-government process has taken over 20 years to realize and came into effect in September 2016.

The community has also a great deal of experience building social capital; specifically, connections to networks outside of the community or bridging social capital – through projects and studies that engage different researchers, consultants, organizations and partners. Much of

this work has been done by community organizations through consulting community members as well as bringing in outside capacity, through hired consultants or researchers, to fulfill their vision or address community-defined questions. As such, Délı̨nę and its regional partners have fostered many partnerships and relationships with academic institutions and organizations, and has built capacity and infrastructure in the community, including research protocols, to formalize research processes in the community. The communities of the Sahtú region have also been active in climate change adaptation work, scoping key issues and identifying priorities for future research and planning (Délı̨nę First Nation 2010, Lim et al. 2014, Morgan et al. 2015). This project aims to build upon this regional understanding of climate change, and create a detailed food security and adaptation plan for the community of Délı̨nę with the goal of providing good practices for other communities in the region to adopt or modify to suit their needs.

4.2 Methods

Climate change vulnerability and adaptation strategies were explored through an adapted PAR methodology. This ensured that the research would be community driven, is responsive to the needs of the community stakeholders and furthers the goals of social science through co-learning and building a collaboration of researcher and community (Gilmore et al. 1986, McTaggart 1999). As community members in Délı̨nę have experience with social science studies, the organizations that were partners in this research, including the Sahtú Renewable Resources Board (SRRB) and the DRRC, have their own protocols. Much of the research methodology builds on existing frameworks to foster community collaboration, engagement, and trust building, and were culturally appropriate (outlined in Caine et al. 2007, McGregor et al. 2010, Tondu et al. 2014, Simmons et al. 2015). This approach has origins in community empowerment,

social action and community health and development (Wallerstein and Bernstein, 1994; McTaggart, 1999; Altrichter et al., 2002).

A key principle of the approach was to encourage as much opportunity for community engagement and participation as possible (Minkler and Wallerstein 2011). Throughout the process of developing the proposal for this project, information was sent, via emails or letters, to various decision-making bodies, organizations and the broader community to raise awareness of the project. This was done to help solicit support, interest and input from the community for the project. Community partners identified and recruited a diverse group of participants to take part in planning meetings, including Elders, youth, and active harvesters, who were able to share their knowledge of the changes observed on the land. This group became informally known as the steering committee, and was involved in all aspects of the research planning, including meetings and conference calls that were aimed at making committee members familiar with the research process and the researchers themselves. These meetings served as a valuable opportunity to share insights into the research and develop community-relevant questions and methodologies that reflected how the community wanted to be involved in the project. These actions served to build trust and foster open and transparent communication between all parties (Pearce et al. 2009a, Tondu et al. 2014).

Other integral aspects of the project were two on-the-land camps that were planned to coincide with the fall and spring research visits. These camps were planned to help facilitate meaningful opportunities for community members, particularly youth, to be on-the-land learning skills from their Elders and harvesting foods to bring back to others in the community. Furthermore, this

learning environment allowed the researchers to gain a deeper understanding of the culture and traditions of the community (McGregor et al. 2010, Bartlett et al. 2012, Simmons et al. 2015). These opportunities also facilitated informal discussion around research topics and the building of trust and relationships (Tondu et al. 2014) and embody the spirit of participatory action research as these experiences can achieve both research and community goals. The camps, however, proved difficult to facilitate, with weather and dangerous conditions limiting the success of the fall camp, and planning and timing issues impacting the winter camp. This experience highlights the ongoing evolution of community-based research in the North. The process of building trust and spending time and sharing experiences in the community is valuable, as is a highly flexible and patient approach to the research. Sometimes, the pressures between data collection, funding and reporting deadlines, community commitments, and the weather do not always come together. But building good relationships with community partners and good communication with research participants, helped to modify plans to accommodate for last minute changes. PAR was, therefore, the goal and the spirit of the research conducted in the community, and may eventually be achieved through ongoing collaboration and communication with community members.

In all, 13 community members participated in semi-structured interviews. Interviews were conducted in September 2015, with each interview taking approximately one hour and conducted in the language of their preference (North Slavey or English). As most people in Délı̨nę are fluent in both languages, English was predominantly used, but an interpreter was available to consecutively translate both questions and responses when needed. Interviews were mostly conducted in the Délı̨nę Land Corporation offices but some were conducted in other locations if

this was the preference of the participant. Interviews were structured around questions on health, food, changes witnessed over time to the land, and what solutions participants would they like to see to ensure access to food for future generations. The questions were open-ended to further explore specific experiences and expertise of the participant (Hay 2000). All interviews were digitally recorded and participants were reimbursed for their time. A results workshop was held in February of 2016 and was open to all members of the community. This workshop allowed for the opportunity to discuss the project, validate key themes and observations that emerged from the interviews, and begin the planning of the community's food security action plan. Follow up conference calls were conducted in the spring of 2016 to further validate findings of the study and plan and propose future projects as determined by the study results. This research approach and methodology was approved under Research Ethics Board of Wilfrid Laurier University and through the Aurora Research Institute (License number 15746), the research licensing organization for the NWT.

4.3 Results and Discussion

4.3.1 Describing the Community Food System

In Délįnę, like many other communities in the North, health and well-being are linked to the health of the ecosystem – the land, animals and water but also access to traditional foods (Parlee et al. 2007, Loring and Gerlach 2009, Parlee and Furgal 2012). In general, participants described how they feel that Délįnę is a healthy community because the relationship to the land remains strong, as many people depend on the land for their livelihoods and their diets are maintained by traditional foods.

> "Health in Deline, well, from knowing from way back from our grandparents, they lived on the land and had traditional food and they were always healthy. And you could see that, they were always up early every day, going, working, they were always energized...Health is going out on the land, having that fresh air, being with nature. Living off the land and taking care of your water and the animals, and that's health."
> ~Joey Dillon

The land, waters and surrounding ecosystem play an important role in the lives of the community and is fundamental in their identity and sense of place, and food system. Due to the location of Délı̨nę, on the shores of Great Bear Lake, water became a common theme throughout the interviews. The lake was identified as the most important asset in the community; it is what makes Délı̨nę the place where people want to live and plays an important role in their lives, physically, mentally and spiritually.

> "The water is gold to Délı̨nę people."
> ~Bertha Kenny

The lake is also woven into stories and prophesies told in the community, making it important, not only to natural capital, but also to cultural capital. It is the main method of transportation in all seasons to harvest food, but is also the source of much of the community's food supply, as fish is an important staple. Many participants commented on how easy it is to just get in a boat

(an important, but expensive tool for harvesters), get onto the lake and go catch fish, and the escape the lake provides to life in town.

> "The Elders say is our freezer, Great Bear Lake, with all those fish in there."
>
> ~Bertha Kenny

Having access to traditional foods was perceived as the basis of the community's preferred food system. However, there was a concern amongst participants that the community is not as reliant on traditional food as it once was, and that is having an impact on peoples' health. Participants discussed the many changes that have occurred during recent decades that have influenced health in the community, including the changing relationship with the land. Transition into permanent housing, water delivery, fuel heating, the need for jobs, moving away from dog teams to skidoos and the dependence on food from the store all play a role in changing the way the community members maintain their livelihoods.

> "That's when everything changed, when they brought up all this government housing, in 1968. I know, they left everything. Everyone left their dogs, and their bush life. Everything."
>
> ~George Kenny

The introduction of processed and sugary foods was highlighted as a major contributor to the perception of poor health in the community and evidence of the nutritional transition seen

throughout Aboriginal communities (Morrison et al. 1995, Kuhnlein and Receveur 1996, Kuhnlein et al. 2004). As one Elder explained:

> "I remember way back in 1960 - 65, the doctor came in and he found the kids are very healthy. The girls and boys that were very healthy. They played lots and they worked lots. They were very strong and very tough. They do a lot of work but they don't feel it, because they are so healthy. And now all these different things, different food coming in, chemicals...candies and pop. Their health is not the same."
>
> ~Charlie Neyelle

The changing relationship with the land that has happened over time is illustrated now through concerns for the future of food in the community. The younger generation are generally perceived to not have the same relationship to the land, know the language nor possess the skills and experiences needed to survive on the land or bring back food for the community. There are concerns about where their food is going to come from if there is a lack of skills needed to maintain traditional foods as part of their livelihood in the future. Global and societal changes are having an impact on Délįnę, particularly their food system.

Applying the CCF to information obtained from interviews, conversations, and other background descriptions of the community, the factors influencing the food system (both positively and negatively) are outlined in terms of capitals in Table 5. In Délįnę, the social economy is strong, and the community has done a great deal to maintain and build cultural capital though

community-based programming (Harnum et al. 2014, Simmons et al. 2015). Food sharing is a common practice, and seen as a way to support those who are not able to be on the land.

> "We always go to Deerpass Bay, good fish at this time of year. And we come back we share fish with the [Elders], that's what we do. And we're not wasting any."
> ~Paul Modeste

Natural capital is perceived as being abundant, with a pristine environment providing access to traditional food sources. These capitals are the drivers of the food system, where Traditional Knowledge and social practices allow community members to access food from the natural capital. But, as discussed, the ongoing social and cultural changes in the community may serve to limit the replenishment of these capitals over time, which is the cause for concern regarding the lack of skills for the next generation of harvesters. Financial capital is now needed to pay for gas, equipment and supplies to access food from the land and required for the increased reliance on food from the store. As financial capital may not be available for some individuals, the pursuit of employment to pay for supplies or other costs of living can take away from time in the community and on the land, further limiting social and cultural capitals. Human capital is now required to service modern harvesting tools, such as skidoos and small engines, and is not always accessible in the community, especially when technological advances in such equipment requires new skills and more technical equipment to service. The community's food system also relies on winter roads and weekly airplane food deliveries (built capital) to bring fresh food supplies, as well as other goods into the community. Délı̨nę does possess a great deal of political capital, achieved through the Comprehensive Land Claim and advanced through many community-led

initiatives such as self-government. This community power and influence over management of natural resources is currently being tested in ongoing discussions regarding caribou conservation. Although a brief snapshot of the community's food system, one can see the levels of complexity and interactions between the capitals, and the reliance on certain capitals and infrastructure to maintain the food system. Now, and maybe most importantly, the pressures of climate change on community's natural capital, and impacts on other capitals, will add more pressure on that food system.

Table 5. Summary of the community's food system based on capitals, and how key findings, as identified through interviews and background research, either add to (+) or deplete (-) these capitals.

Capital	Key Findings
Social	(+) Strong social economy (e.g., food sharing) (+) Close-knit community (+) Experience with networks outside of community (-) Social change due to global pressures
Cultural	(+) Reliance on traditional foods (+) Maintaining traditional practices and activities (+) Many are fluent in their traditional language (-) Language as barrier to transfer of Traditional Knowledge (-) Some youth not as engaged in traditional foods and activities (-) Changes to relationship with land
Natural	(+) Abundant sources of country food (fish, moose and others) (+) Great Bear Lake (-) Declining caribou herds
Financial	(+) Access to community funding and government grants (+) Comprehensive land claim (-) Limited availability of jobs in community (-) High cost of living (food, gas and supplies)
Political	(+) Multiple layers of government (+) Comprehensive Land Claim (+) Self-Government (+) Co-management of resources (+) UNESCO Biosphere Reserve Designation
Human	(+) Engaged community (+) Educational opportunities in community (+) Employ consultants to fill capacity voids
Built	(+) Community services (water, wastewater and health) (+) Access to stores (-) Fly-in community (winter road access only)

4.3.2 Climate Change Impacts on the Community Food System

Climate change is having a noticeable impact on the ecosystem; through interviews, participants described how these changes to the land are impacting the community. Community members spoke of changes in temperature, noting that it is not as cold as it has been in the past; they have also seen a change in the temperature of the lake, particularly in the past few years. People notice

that the fish they catch in their nets spoils much faster than before. As one interviewee commented:

> "Way back, people set their net and they could go check it two days later and all the fish would be still fresh. But now, the old people have been mentioning it for a few years now, that if you don't check your net you get some spoiled fish on there because the water's getting warmer."
>
> ~Freddie Vital

Therefore, adaptation in this case means more trips on the lake to check the nets, and taking more resources in the form of human and financial capital to harvest similar amounts of food. Lower water levels on the lake and surrounding rivers was also noted as an area of concern as was a change in the availability of some fish species. Some species of fish have declined in numbers and are no longer available in some of the locations where they were traditionally found.

> "[Some fish] go someplace else but all the big trout they all go there, but they're all gone now. There used to be lots of fish there. The herring, I don't know where they moved."
>
> ~George Kenny

Furthermore, some people have noticed changes in fish health, including parasites and changes in taste. Key informants also shared their observations that travel on the lake has also become

more unpredictable. The wind can change rapidly, bringing waves and unsafe conditions that can have severe implications on travel plans, as experienced by the research participants as travel to the fall on-the-land camp was postponed several times due to the sudden, and dangerous, change in conditions. Although rapidly changing weather has always been a risk associated with travel on such a big lake at certain times of the year, members of the community reported that it is now more difficult to predict.

> "It is riskier, especially in the fall and spring when the wind starts picking up and it gets cold and freezes. It's way more dangerous to travel on the lake."
>
> ~Ted Mackenzo

There are many stories and experiences by community members of being delayed or stuck on the land due to weather. One story involved an Elder that was stranded on the lake due to a mechanical breakdown. He survived through severe weather, drifting on the lake, and ultimately fashioning a sail to make his way to land. In this more extreme example, it was through the years of experience and the combination of having the right tools and quick thinking that led to his survival. Participants remarked that if it had happened to anyone else, it might not have ended as well, again underlining the importance of learning a diversity of skills and spending time on the land in all types of conditions. The community is aware of the dangers of travel, especially during lake freeze-up and break-up, where travel plans may not go as expected. Bringing extra supplies, traveling with small groups, and being more cautious when travelling are some of the adaptations used to enhance safety, but these are not necessarily practiced by all community members.

The overall changes in weather observed by the community, including rain events in December and difference freeze/thaw cycles in the spring, may be changing the nature of the snow and have been shown to impact animal foraging, particularly caribou, vegetation and human activities in other regions (Bokhorst et al. 2016). Although significant changes to the landscape through the impacts of permafrost thaw are minimal, the community did report instances of slumping of some riverbanks and hillsides around the lake as well as changes in the freezing of muskeg, increasing the risk associated with travel in certain areas. Most importantly for the community are the changes they have witnessed in animals, particularly species that are important food sources to the community, including caribou. The community has seen the numbers of caribou decline and commented on how far they need to travel in search of caribou now.

> "There was a lot of caribou across the North shore. They don't come here. This time of year there were lots out there, but now they're all gone."
>
> ~George Kenny

Their accounts, paired with reports regarding the significant decline of Bathurst East caribou herd, as well as other barren-ground herds in the NWT (Adamczewski et al. 2012, Boulanger et al. 2014), have led to a deep concern in the community as to what to do to help the caribou. At this point, the research intersected with the community's caribou conservation plan, known as *Belare wíle Gots'ę ʔekwę –Caribou for All Time* (Délı̨nę ʔekwę Working Group, 2016) which was being developed concurrently to this research. The community's plan proposed to limit the harvest of caribou for the next three years to ceremonial purposes only, outlined key approaches

to conservation based on Traditional Knowledge and relationship with the caribou, and enforced their decision-making and monitoring rights as outlined in the Comprehensive Land Claim Agreement (Délı̨nę Ɂekwę́ Working Group, 2016). This synergy, between the food security and the caribou plan, offered an interesting insight into community conversations about the importance of caribou, and the difficult decision to restrict the harvest of caribou, a right outlined in the land claim agreement and a polarizing issue within the community and amongst the other communities and regions that depend on that resource.

> "I agree with both situations; you can't take people away from their hunting. We used to go to one place that year and the next year someplace else, they let it heal, they let the land heal and the animals grow. That's important nowadays. Everybody needs to learn to value it. Like now a lot of people's minds are like you can't take that away from us. And they are right too. But in a way we have to teach ourselves how can we manage it for a long period of time."
>
> ~Anonymous community member

Making the difficult decision to limit the caribou harvest is an example of the community using its political capital to determine its own food system and offers a unique insight into food sovereignty in the North. Food sovereignty is a concept where communities define their own food system, and is largely based on the right to food (Patel 2009, 2012). While the right to harvest country food, is granted through the Sahtú Dene and Métis Comprehensive Land Claim Agreement, the community is invoking the right as stewards of the land to protect this important resource for future generations. Although this may have short term consequences on food

availability in the community, the long-term health of the caribou and other animals, is in the best interest of everyone, including future generations.

> "[If we] hunt all the caribou or fish out the lake, then what would happen to this unborn generation? How they survive but all these things disappear? And the trapping, no one's going to teach them how to do it. So what I'm looking at is to try to save as much as we can for the next generation, for the unborn generation. We have to think about them not only today but in the future.
>
> ~Paul Modeste

What emerged during discussions with participants was the language of self-sufficiency, where the community would not have to rely so heavily on goods, particularly food, being transported from the south. Although many community members admitted that they will still need that link for many commodities (fuel and some food for example), they also observed that links to the south would not be as reliable due to the impacts of climate change in the future. This point was highlighted during the research visit in February 2016 where the condition of the ice road was so poor that it had yet to open to heavy truck traffic. This was a major delay from previous years and led to an increased sense of anxiety in the community about whether supplies would reach the community that year. A week later, the road was opened to heavy truck traffic and a fuel truck fell through the ice on its crossing of the lake (CBC News 2016). It was only the eleventh truck to make the crossing with many more to come. Although the fuel was safely removed and the truck was lifted out of the ice, it was a stark reminder of the need to promote the solutions that community members wanted to see to build a more sustainable food system for the future.

4.3.3 Adaptations Based on Past Experiences

Making changes to the community's food systems involved two key themes that emerged during interviews: learning from the past, and gaining new knowledge from outside the community. Learning from the past involves sharing Traditional Knowledge and skills within the community and thereby strengthening the social and cultural capitals within the community. This also encompasses how the community has adapted to past events, such as fluctuations in climate (Ford et al. 2006b) or, in the case of Délı̨nę, changes in food availability. For example, the current situation with the Bluenose East caribou herd and reducing the harvesting of that species is not unlike a situation the community experienced in the past. During interviews Elders shared stories of the time there were no barren-ground caribou around Délı̨nę for the community to harvest for 30 years. When asked how the community coped with the loss of caribou, Elders highlighted a variety of other animals that the community used for food sources and the importance of sharing food.

> "Moose, lots of moose…and fish, trout, whitefish… the other caribou, woodland…."
>
> ~Charlie Neyelle

Elders acknowledged that it was not an easy time for the community, but they worked together, shared food, and adapted by being flexible in what was harvested. Fast forward to today: there is a concern regarding the community's dependency on caribou and the lack of variety of species harvested. And that knowledge of when and where other food sources were traditionally

harvested in and around the area is not readily available. It is therefore a priority of the community to document and map these important locations with Elders, and ultimately share this knowledge with community members and harvesters. This will ensure a more sustainable harvest of traditional food sources by increasing the variety of both species and locations, but also by visiting sites they have not returned to in years and even returning to species they have not harvested in years as well. Admittedly, it will not replace all the food that they have come to depend on from the stores, but will help to shift back to more local sources of food and increase self-reliance and available food for the community. This shift to a broader range of locations and species does come at a cost – of fuel, supplies and time (predominantly human and financial capitals). Although the local agency, the DRRC, will help with some of the financial burden by providing gas to land claim beneficiaries for the harvest and sharing of food with the community, it will take a more coordinated effort to shift harvesting practices back to those used in the past. This shift towards traditional harvesting timing and location is also not without risk. Traveling to places farther away from the community adds costs and makes harvesters more vulnerable to the risks associated with the changes in climate described earlier. Furthermore, as some of these locations have not been visited for years, it is unknown what the health of the land or species availability might be in these areas. Families that harvested at these locations in the past also maintained cabins or camps and spent a great deal of time in those areas, and knew those areas well. Recapturing that information from past experiences, and revisiting and assessing these harvesting locations will be important for the future of the food supply in the community.

What is also important, then, is that community members have the knowledge to properly harvest and respect a variety of animals along with safety and survival skills. With the new challenges

and risks associated with the changing climate, harvester safety and being respectful of cultural traditions on the land are paramount as the community chooses to continue to utilize traditional foods as the basis of their food system. Young harvesters must be provided with the opportunity to learn and practice skills on the land, under the guidance of community Elders and knowledge holders, and be encouraged to become harvesters, trappers, food providers and positive role models in the community.

> "We have to start teaching our young people to live off the land by themselves. Like in the old days, people used to make their own homes, tents with spruce, and even how to make fire out there on the land. That's what we need to teach our young people"
> ~Leon Modeste

There was interest in integrating on-the-land learning into the school, and creating more opportunities for the youth to learn the language. Getting youth interested in cultural practices and activities was seen as important to do at an early age, but many participants highlighted barriers to implementing some of these changes. Young children do not, generally, speak the language because it is not being taught or spoken at home. It seems that young parents with children do not generally speak the language as they were brought up in schools that taught in English only.

> "Yes, our generation is okay with the language, but our children who are just young parents now, they are the ones that are losing the language. And that is who we should be concentrating on."

~Bertha Kenny

Providing community members with experience on the land as families or large groups was seen as the ideal way to learn skills and reestablish bonds with each other and the land as well as reconnecting with the language. Language is the key to understanding Traditional Knowledge and skills.

"They have to learn their language, then they'll know everything."

~George Kenny

Language was a key component of the community's approach to self-government and caribou conservation. And participants wanted to see programming aimed at incorporating language education and Traditional Knowledge and skills into programming, either through the school or through another organization in the community. The possibility that self-government may provide a vehicle to deliver a more culturally appropriate education in the community was raised as part of several interviews. In Délı̨nę, perhaps, political capital may be the key to building and maintaining cultural capital, and the community appears to be allocating other capitals within the community to achieve this goal. Learning and sharing Traditional Knowledge from within the community also requires bonding social capital to support the maintenance of cultural capital and therefore, the food system of the community, something the community has been working on through their vision of self-governance as well.

4.3.4 Adaptations Through Creation of New Knowledge

Although community priorities for adaptation relied on the building of capitals through strengthening of community bonds (social capital), sharing of Traditional Knowledge (cultural capital) and through their political capital, there was also an emphasis on bringing new knowledge into the community to help build a more sustainable food system. And sometimes the combination of the two were seen as solutions for the community. Through interviews, growing food was identified as a key way forward for Délı̨nę to become more self-sufficient and food secure in the future as well as for decreasing their dependence on expensive store food.

> "Because everything here is so expensive. If we do our own garden, if people want some stuff they can just get some. Share."
>
> ~Bertha Kenny

Potatoes were a key food source that people wanted to see grown in the community, but many cited the lack of knowledge around gardening in the community amongst the Dene people.

> "Someone has to look after us and teach us."
>
> ~Dora Blondin

Although gardening has been done in the community, most of it has been through people from outside the community who grow food for a while and then leave, taking the skills needed with

them. The current garden is operated behind the community's nursing station and provides food to a small portion of the community. There are Sahtúot'ine currently involved and even more are interested, so scaling up the existing community garden, while working to build capacity, knowledge, and interest in the community around growing food, is important. If the capacity to grow food already exists in the community, creating more opportunities to learn and share this information within the community may be a way forward. Growing food, combined with gathering of more food from the land, is an example of how the community wants to look both forward and to the past to build a more sustainable food system.

Another example was enhancing safety for those on the land. Providing technology such as satellite phones or other emergency communication devices was recommended by many harvesters; so was the mapping and sharing of information from areas around the lake that were traditionally used as safe harbours and good places to stay (e.g., cabins) while waiting out bad weather events. There was the acknowledgement that an inventory of these resources needs to be made, such as the conditions of some of these areas and if they are still indeed safe areas. This exercise would also provide community members with a resource that would enable them to wait out weather events, which are harder to predict, instead of taking the risk of travelling through them.

Building the food system to be more self-sufficient also does not always have to rely on new skills and knowledge either. Many community members mentioned that musk-ox are now present, and even plentiful, in the area but are unsure of the viability of the species as a substitute for caribou in the community diet. Often musk-oxen were described negatively, as competition

for caribou for food and space on the land, or the fact that caribou dislike and avoid musk-ox, a story supported in other NWT communities (Wesche and Chan 2010). However, there was some interest in trying it, mainly if it would help the caribou. As one participant noted:

> "I have a buddy from Nunavut and says the meats the same. But if I get a chance I'll try to get a calf there. The meat should be nice and tender, just to try it. There are lots of people saying that they're all over."
>
> ~Freddie Vital

Although there are examples of climate change creating opportunities for other species to become important food sources for communities in the North, these cases have involved harvesting more of a traditionally less-harvested species (Ford et al. 2006a, Wenzel 2009). Musk-ox, in particular, have not been harvested in Délįnę in the past, so there was concern that there was a lack of skills to properly harvest them, or if it was appropriate to do so, since the community had no experience with this species. Food substitutions, therefore, may not be culturally acceptable for some communities. However, there was interest in learning more, with the possibility of talking to other communities and harvesters to bring in this knowledge. In a sense, it would be sharing Traditional Knowledge from other communities to aid in adaptation: communities learning from other communities. The community will have to decide if this is an appropriate substitution for them.

Many of the solutions proposed by the community involved monitoring the lake and the resources around the lake to ensure the entire ecosystem is healthy and protected. The basis for

this is not only dependence on the lake for their livelihoods, but the role that Great Bear Lake plays in community beliefs and culture. Monitoring, it was felt, gave the community the voice as the protectors of the lake, and the ability to assert their rights to the land and fulfill their wish to be stewards of the lake. However it was perceived that much of the monitoring, of water quality for example, was done by outside institutions, and participants felt that findings are not shared with the community. Community members indicated the need for more participation in ongoing monitoring initiatives, but highlighted the importance for better communication of results to the community.

> "Non-Dene researchers and scientists, we need to work together and help each other learn about the land, learn about the animals. We know for a fact that right now the caribou is in decline. And we have to deal with it, we have to work with it. Not only that, but we know for a fact that the water level is also low. So those kind of things we need people, scientists that are knowledgeable about that to come and work with us, and share information with us."
>
> ~Leon Modeste, Elder

Making the scientific knowledge more available would help community members better understand the changes on the land and the health of the ecosystem, and aid in adaptation and decision making (Armitage et al., 2011; McCarthy et al., 2011). With increasing uncertainty around the impacts of climate change on species, such as caribou, and the realization that some Traditional Knowledge may no longer be applicable in the changing climate, the need to supplement traditional ways of knowing with evidence-based decision-making through scientific

knowledge becomes critical. Many participants wanted to see scientific knowledge and studies focus on important issues for the community, and wanted to see the community also contribute to this research. Many also wanted to explore options for community members to learn more about monitoring and other related skills to ensure the health of the environment. They wanted to ensure that everyone treated the lake with respect and that the health of the lake was the priority, as many voiced their concerns about site remediation, older contaminated sites, and current use of the lake by others, not to mention uncertainty about the impacts of climate change around the lake.

> "Another thing about protecting the water, I don't know what can happen in the future but for Great Bear Lake we have to make sure it is looked after too. No pollution or nothing."
> ~Paul Modeste

Building a food system that is resilient to the impacts of climate change will be a challenge to all northern communities. Examining the food system in Délı̨nę, one can see that multiple stresses, including climate change and other social and cultural changes, are impacting the capitals of the food system. The community, however, is actively adapting their food systems in the face of climate change, and has a vision for building a more resilient food system through the building of capitals that support the community. A detailed list of the capitals required to build a more sustainable food system are given in Table 6. For Délı̨nę, the emphasis has been put on building social and cultural capitals through promoting intergenerational knowledge transfer and emphasizing quality time together on the land. The building of bridging and bonding social capital and the sharing of knowledge across scales can help in the formations of new linkages

and opportunities for the food system (Levkoe 2011, Blay-Palmer et al. 2015). As witnessed in this research, adding new knowledge was important to moving these community-defined food system projects forward to meet the vision of the community's food system. Equally, there was a focus to relearn, rediscover and share information already present in the community, allowing the reemergence of a sustainable food system used in the past. This does involve strengthening relationships within the community, but also requires harnessing the community's cultural capital as key elements of a more sustainable food system lie in the Traditional Knowledge of the community. Accessing stored cultural capital to learn from the past should be the basis for culturally acceptable adaptations (Adger et al. 2009, 2012, Pearce et al. 2015). All these elements were captured in the community's food security action plan titled: Dene béré belarewílé Ensuring food security for future generations in Délįne (Appendix B)

As communities define their food system based on place and local circumstance (Blay-Palmer et al., 2015; Marsden, 2012), in the context of the CCF, it emerges out of the capitals that are available to the community. It is, however, cultural capital that emerges as a defining capital in the food system in Délįnę. Cultural customs, practices and Traditional Knowledge play a major role in food systems across northern communities as well as in their sense of place and identity (Wilson 2003, Cunsolo-Willox et al. 2012) and is becoming the focus of adaptation strategies in the region (Crane, 2010; Pearce et al., 2015). The importance of cultural capital is what makes the food systems here unique, and is captured within the CCF as a lens to examine the system of food systems in Délįnę.

Table 6. Community capitals required to build a sustainable food system in Dél̨nę

Capital	Adaptations
Social	More community hunts (involving families) and time together on the land Increase communications amongst harvesters to report conditions on the land Create relationships (outside of the community) to bring in new knowledge
Cultural	Learn from past experiences and share Traditional Knowledge Language programming Promote on-the-land camps / events when possible Engage youth and create mentorship opportunities
Natural	Increased research and monitoring
Financial	Resources needed to fund community-defined programs Self-government able to allocate funding to community initiatives
Political	Continue to build through self-government and Biosphere Reserve Monitoring lands
Human	Skills and training needed for initiatives (gardening, mapping, etc.) Promote harvester safety
Built	Infrastructure and tools required programs and initiatives (gardens, etc.)

It should be noted that this research brings together a community-led investigation into the vulnerability of the food system to the impacts of climate change with a novel framework to envision that food system. The PAR approach taken leads to developing a community action plan to address issues impacting the food system, but the framework was not part of that PAR work. The CCF is used as an academic theory to frame dialog around food systems. Conversations with community members introduced the idea of these capitals but language used as part of interviews did not directly involve discussions of capitals, per se, but of how these capitals are experienced at the community level. For example, capacity and training were themes that emerged during interviews, but the term human capital was applied to these words during analysis of interviews and not by the interviewees themselves. Although the framework of the CCF can be used to inform how action and policy can contribute to a more resilient food system, community action plans focused on plain-language descriptions of these capitals. Again, this highlights the constraints of PAR in communities, but shows how further dialog and

communication can help to bridge this gap and have communities truly engaged in the research process. Further work would also incorporate the greater use of Dene languages and terms to help foster greater community engagement in the research process.

4.4 Conclusion

Climate change is a reality for communities in Canada's North and brings changes to the land, water and animals communities depend upon. Through a dialog with community members this research highlighted the needs for different types of knowledge to flow within and into the community to enhance adaptation and secure food for the future. As traditional foods are the basis of the preferred food system for Délı̨nę, knowledge to support the harvesting and gathering of these foods is central to the community's plan moving forward. A community vision of self-sufficiency also emerged as part of this research. Self-sufficiency, as described by participants, involves not having to rely on goods coming from the south, but also focusing on building capacity in the community for people to feed themselves from the land as they have done in the past and through new skills such as growing food. By maintaining traditional foods as the foundation of the community's food system and increasing local production or gathering of other foods, the community envisions a future with continued access to safe, affordable and culturally appropriate foods, meeting the criteria of community food security (Hamm and Bellows 2003). To achieve this goal, however, relies on building and strengthening capitals as part of the food system. Key to building capitals is the transfer of knowledge, both in terms of traditional skills and knowledge from within the community (social and cultural capitals) as well as other types of knowledge, including education, skills, as well as monitoring and science, from outside the community.

In the UNESCO Tsá Tué Biosphere Reserve, there is the opportunity to watch food sovereignty unfold in Canada's North. Due to the presence of such high amounts of political capital in the community, and thanks to the comprehensive land claim; as of September 1, 2016, Délı̨nę becomes the first Indigenous community in Canada to be self-governed. The community is reimagining their food system as one rooted in both their cultural values and Traditional Knowledge and new knowledge from outside the community. As another example of the food politics of the possible (Blay-Palmer et al. 2015), this community has the opportunity to shape their food system to be based upon cultural capital and the Traditional Knowledge systems of the people. Utilizing the CCF, this research has identified community strengths as well as gaps in the food system and offers insights into how to develop capitals to build resilience into the food system. Future work is needed to examine how the community's high level of political capital, which is still evolving with the recent implementation of self-government, shapes the food system. It is hoped that through this process, the Tsá Tué Biosphere Reserve will offer a unique case study in both northern-specific, and contemporary global food studies.

5 The Geography of the Northern Food System: A comparison of case studies and community capitals in Canada's North

Abstract

Food insecurity in Canada's North is a complex issue that requires place-based solutions. This research compared case studies in food systems conducted in two Indigenous communities located in the boreal forest of Canada's Northwest Territories. Through a participatory action research methodologies, members from both communities spoke about the impacts of climate change on community health, well-being, and issues of food security. Using a Community Capitals Framework, each community's food system was described in terms of availability of capitals and was used to highlight strengths, issues and barriers faced in achieving food security. Results indicate that the food systems in these communities share common traits, but are distinct in many ways. Each food system is shaped by issues of place, scale and space. In the cases of Délı̨nę and Kakisa, NT, these differences are highlighted by examining factors including community size, location, access to road networks and community infrastructure, and access to political capital. The presence or absence of these features requires each community to allocate capitals to compensate or enables each community to spiral up and build other capitals important to the food system. Creating space for communities to discuss and define issues around governance and protection of land and food resources emerges as a critical piece of the food security puzzle in the North. This research reaffirms the complexity of food systems in the North, and indicates how one capital cannot be built in isolation from the others.

5.1 Introduction

Food systems around the world are diverse. Driven by geography, issues of space, place and scale have shaped the relationship people have with food (Shanahan 2002). On a global scale, our food system has evolved through technological advances to produce and distribute food to feed an increasing global population, but at a cost to the environment (Horrigan et al. 2002, Godfrey et al. 2010, Tilman et al. 2011) and the uneven distribution of food throughout the world (Swinburn et al. 2011). However, it is at the local scale that alternative food systems are gaining momentum to emphasize local food production and food networks that seek to add sustainability and social justice, and shift control back to communities (Feenstra 2002, Levkoe 2011, Blay-Palmer et al. 2013a, Knezevic et al. 2013, 2017). Although these emerging food systems may share some commonalities, they are products of local circumstances and are connected to and shaped by place (Marsden 2012). In Canada's Northwest Territories (NWT), the food systems of Indigenous communities developed out of the close relationships with the surrounding land, water and animals and are built on the customs and traditions of the peoples. The sense of place in Indigenous communities has a great significance to their well-being and way of life (Wilson 2003, Cunsolo-Willox et al. 2012). However, the relationships with the land have been changing due to political, environmental and socioeconomic factors that have dramatically impacted communities over several generations (Power 2008, Wesche et al. 2016). Now individuals have increasingly become dependent on the wage-based economy instead of the traditional economy to support their livelihoods. This is illustrated by the transition in diets of Indigenous communities across the globe away from traditional foods produced locally to food purchased at stores, which has resulted in the increase in diet-related health issues (Kuhnlein and Receveur 1996, 2007, Popkin 2002, Kuhnlein et al. 2004, Council of Canadian Academies 2014). With the

high cost of food as well as other goods and services across the North, the increased expense associated with harvesting food from the land, and now issues of climate change impacts that limit both access and availability of traditional foods, a food insecurity crisis has emerged. Regionally, rates of food insecurity range from 24% to 43% which are dramatically higher than the national average of 8% (Rosol et al. 2011, Council of Canadian Academies 2014, Tarasuk et al. 2016).

What is clear is that there are fundamental challenges for food systems in communities across the North that result in high levels of food insecurity. These issues are complex, and involve a variety of actors, scales and resources. To achieve some clarity, and contribute to this ongoing discussion, this paper proposes using the Sustainable Livelihoods approach (SL) as a more comprehensive way of examining food systems in the North. SL emerged from earlier poverty, development and vulnerability studies (Chambers 1992, Scoones 1998), combining capabilities (Sen 1993, Nussbaum 2001, Robeyns 2006) with the idea of capitals, or vehicles of action used to live (Bebbington 1999). This approach examines the capitals, capabilities and assets people need to make a living (Scoones 2009) and may better reflect approaches to food systems in the North as Indigenous communities combine aspects of the social, traditional, and wage-based economies to maintain their livelihoods (Usher et al. 2003, Abele 2009, Loring and Gerlach 2009, Dombrowski et al. 2013a, Harnum et al. 2014, Simmons et al. 2015). SL approaches, in various forms, have been utilized in climate change adaptation and resilience literature, food security studies, and community development and planning (Levine et al. 2004, Emery and Flora 2006, Ashwill et al. 2011, Nkem et al. 2013, Stone and Nyaupane 2015, Connolly-Boutin and Smit 2016, Penn et al. 2016). For the purposes of this study, the Community Capital Framework

(CCF) is used to describe community food systems in terms of available or depleting capitals. The CCF differs slightly from other SL approaches in that it is based on seven dimensions of capital contained within a community: natural, social, cultural, political, built, financial, and human. Each capital is detailed in Table 7. Description of Community Capitals (Source: Flora et al. 2004). In the CCF, as interpreted here, capitals are viewed as individual systems that interact with one another and can be used to create capitals or resources that contribute to healthy, vibrant communities, economies and ecosystems (Flora et al. 2004, Emery and Flora 2006). This approach is comparable to other emerging definitions of food systems, including complex adaptive systems (Stroink and Nelson 2013) and systems of systems (Hipel et al. 2010, Blay-Palmer et al. 2015) and are defined by place and local circumstances (Marsden 2012). It is hoped that the CCF will overcome the critiques of SL, namely that it does not address issues of scale or deal appropriately with power relationships and governance issues (Scoones 2009). It is the intent of this research to illustrate how a systems approach to capitals, through the lens of the CCF, can address the shortcomings of SL approaches, and identify strengths, gaps and opportunities to build a more sustainable food system, particularly in the face of climate change.

The emergence of local and sustainable food systems uses food as a driver of social, economic and environmental change and, ultimately, sustainability on local levels (Christy et al. 2013, Blay-Palmer et al. 2013b, Hinrichs 2014). These local food movements have also led to a refining of the concepts of food security, ensuring the socio-cultural aspects of place are included, while empowering communities to define what food means to them (Hamm and Bellows 2003). This introduces concept of food sovereignty, where communities define their own food system, and is largely based on the right to food (Nyéléni 2007, Patel 2009, 2012).

Although originating from peasant movements, the notion of food sovereignty permeates the food system dialog as the basis for alternative food systems, particularly in marginalized communities, as a tool for community empowerment. Right to food and, by extension, right to traditional food and lands for Indigenous peoples are also complex concepts that have a role to play in northern food systems (Blay-Palmer et al. 2014). How food systems are determined at the community level, and what circumstances and capitals have the greatest impact on these systems, across scales, is an important conversation.

This research compares two case studies on food systems in Indigenous communities in the NWT: Délı̨nę and Kakisa (Figure 5) that have been featured in previous studies (Spring et al. 2018, Spring et al. in prep). The food systems in both communities were described using the CCF and this systems-based approach was used to determine how each community is coping with and adapting to the impacts of climate change. As climate change is having a direct impact on food security and well-being in communities across the North (Wesche and Chan 2010, Cunsolo-Willox et al. 2012, Douglas et al. 2014, Ford et al. 2014), building food systems resilient to these impacts is vital. As impacts of climate change are being felt in different ways, are compounded by other issues being faced by communities, and driven by the availability of capitals, these case studies show how community vision for a resilient food systems are unique to each community (Spring et al. 2018, Spring et al. in prep). Enabling communities to continually adapt to social and ecological changes is done by building on community strengths, values, and vision (Berkes & Ross, 2013; Ross & Berkes, 2014) but for Kakisa and Délı̨nę, geography (location and remoteness), past experiences and other aspects of the community, including population, drive differences in community capitals. This comparative case study analysis allows

for the examination of how the presence or absence of certain capitals can shape food systems in different ways and how factors of place, space and scale help to drive these differences. This can help to identify policy and actions that are needed to assist communities in determining their own food systems.

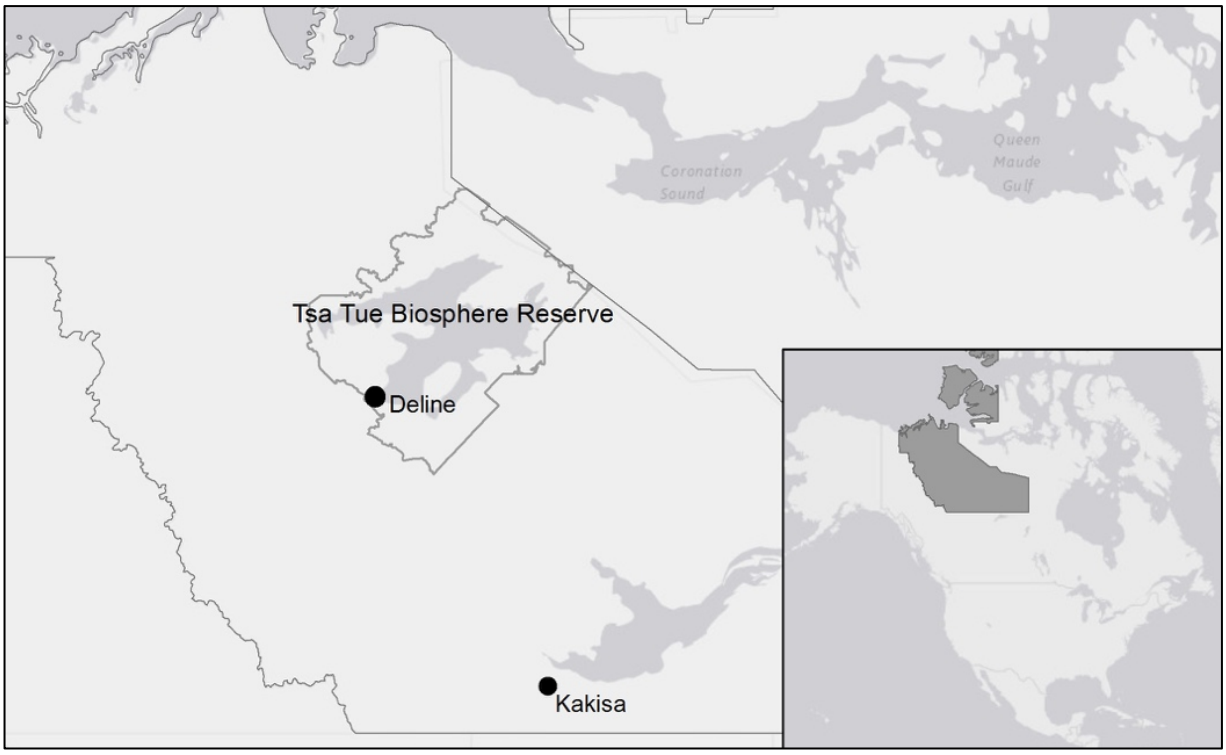

Figure 5. Location of Kakisa and Deline used in case studies for food system comparison.

Table 7. Description of Community Capitals (Source: Flora et al. 2004).

Capital	Description
Social	Connections and networks among people and organizations or the social glue to make things happen.
Cultural	Reflects the way people "know the world" and how to act within it. Cultural capital includes the dynamics of who we know and feel comfortable with, what heritages are valued, collaboration across races, ethnicities, and generations. Cultural capital influences what voices are heard and listened to, which voices have influence in what areas, and how creativity, innovation, and influence emerge and are nurtured.
Natural	Those naturally-occurring physical assets in a location, including resources (e.g., minerals, forests, waterways), amenities and natural beauty.
Financial	Access to financial resources to support community capacity building, social and civic entrepreneurship.
Political	Access to power, organizations, connection to resources and power brokers. Ability of people to find their own voices and contribute to community well-being.
Human	Skills and abilities of people, including access to outside resources and bodies of knowledge to increase understanding and to identify promising practices. Human capital also addresses the capacity to "lead across differences," to focus on assets, to be inclusive and participatory, and to be proactive in shaping the future of the community or group.
Built	The physical infrastructure that supports the other community capitals (roads, buildings, services, etc.).

5.2 Methods

This research highlights the findings of two case studies that were conducted in 2014 and 2015 on issues related to the impacts of climate change on food security in the communities of Kakisa and Dél̨ı̨nę, respectively (Spring et al. 2018, Spring et al. in prep). In both instances, the communities reached out, through partners, to the researchers to begin the process of designing a research project. A modified Participatory Action Research (PAR) approach was used to engage with the communities and ensure the research is community-driven and that it responds to the

needs of the community stakeholders through the active collaboration of researcher and participant in co-learning (Gilmore et al. 1986). PAR methodologies emerged from community empowerment, social action and community health and development literature (Wallerstein and Bernstein 1994, McTaggart 1999, Altrichter et al. 2002), and have been used in transformative action in climate change adaptation projects (Campos et al. 2016) and food systems research across Canada (Blay-Palmer et al. 2013), including Indigenous communities (Skinner et al. 2013, Stroink and Nelson 2013). Consistent with other work in the North, which utilized Community Based Research (CBR) approaches (Berkes and Jolly 2001, Pearce et al. 2009a, McGregor et al. 2010, Armitage et al. 2011a, Tondu et al. 2014), research was conducted alongside representatives of the community, observing – but also contributing to – their activities. This work is based on building trust and open and transparent communications, where communities acknowledge the benefits of partnerships and collaborations so they directly benefit the community (Angell and Parkins 2010, Tondu et al. 2014). Like CBR, PAR involves the co-production of knowledge, but links that knowledge to action in the community.
In both cases, this work resulted in the formation of a food security action plan that formed the basis for future work in the community.

The work in both communities originated in late-2013 with preliminary discussions around food-related issues. Funding opportunities for Kakisa were identified and obtained in 2014 through the Health Canada Climate Change and Health Adaptation Program for Northern First Nations and Inuit Communities. An opportunity to access the same fund for a similar project in Délı̨nę occurred in 2015. The research approach taken was similar for both communities, but as both communities have had experience in research before, they have specific guidelines and

expectations for community engagement. As a result, while slightly different approaches evolved based on input from the community, and access to, and cost of travelling to, each community impacted the amount of time spent in each community, the spirit of PAR was maintained throughout.

Initial interactions with research participants happened through a series of conference calls, meetings and community events, attempting to foster as much participation as possible (Minkler and Wallerstein 2011). Community partners identified and recruited a diverse group of participants to take part in planning meetings, including Elders, youth, active harvesters, and other members of the community who were interested in sharing their knowledge of the changes being observed on the land. These events served as a valuable opportunity to share insights into the research and develop community-relevant questions and methodologies that reflected how the community wanted to be involved in the project. In particular, events like these can provide the opportunity for researchers to engage in informal conversation about, for example, the content of the visual material with community members and the opportunity to listen to the stories and concerns of each individual. These interactions served to build trust and foster open and transparent communication amoung all parties (Pearce et al. 2009a, Wolfe et al. 2011, Tondu et al. 2014).

Interviews were conducted in Kakisa during November 2014, and in Délı̨nę during October 2015. Community members who were able to speak to changes experienced on the land, including Elders, harvesters and others, were selectively sampled with the help of community partners and invited to participate in the semi-structured interviews. Interviews were mainly

conducted in administrative offices in both communities, as agreed upon by participants. In some instances, interviews took place in other locations, such as homes or other gathering places throughout the community based on mobility and personal preference of participants. Interviews were structured around a set of questions, but were flexible enough to permit the exploration of more detail based on specific experiences and expertise of the participant (Hay 2000). For both communities, similar questions were utilized. These questions ranged from community indicators of health in the community, to identifying change in the land and community over time. Most importantly, participants were asked what community-based solutions they would like to see to address some of the vulnerabilities identified by community members. In all, 21 community members were interviewed in Kakisa, and 13 in Délı̨nę. Each interview took approximately one hour and was conducted in the language of the key informant's preference (North Slavey in Délı̨nę, South Slavey in Kakisa or English). For all interviews conducted in North or South Slavey, an interpreter was used to consecutively translate questions and answers. Furthermore, questions were modified to suit the participant. For example, Elders were asked to tell stories about their experiences on the land from the past, whereas current land users were asked questions more relevant to present experiences and recent environmental changes (for example, what they see and how it has changed over the past few years). All interviews were digitally recorded and participants were reimbursed for their time.

A results workshop was conducted in both communities to report the preliminary findings of the study back to participants. This workshop allowed for individuals to comment on the findings prior to the finalization of reports and also enabled a discussion about "Next Steps" to determine what actions the community wanted to take to address some of the findings. Essentially, the

community described initiatives they wanted to undertake to build a more resilient food system. This discussion allowed for the formation of a work plan for the community and set priorities for future work. This was a part of the iterative process that builds PAR as well as trust. Results were presented to the community members and participants in plain language documents. This research approach and methodology for both projects were approved under Research Ethics Board of Wilfrid Laurier University and through the Aurora Research Institute, the research licensing organization for the NWT.

5.3 Results and Discussion

Food systems are built on the capitals available to communities, but those capitals can be abundant or limited based on factors of place, scale and space. Based on previous studies, (Spring et al. 2018, Spring et al. in prep), the community capitals associated with the food systems of Délı̨nę and Kakisa were determined and presented in

Table 8. For each capital of the food system, as determined through interviews and other background information, elements had either positive or negative influences on that capital. For example, in both communities, the land, water and animals are seen as being, for the most part, pristine and abundant, and contribute to the natural capital that supports the food system. Similarly, both communities have a strong connection to the land, maintain traditional practices and have strong food-sharing networks that indicate strong social and cultural capitals. However,

both communities are concerned about youth engagement and participation in traditional activates and languages that may deplete these capitals over time. Particularly as both communities depend on traditional foods, if the next generation of harvester does not have the skills to be on the land and bring back food for the community, food security is threatened.

Although there are shared concerns and issues, this comparison illustrates how these food systems are quite similar on the surface, but differ based on a variety of local factors influence each capital. The community foodsheds, the geographical space where these communities obtain their traditional foods (Loring and Gerlach 2009, Ford and Beaumier 2011) are spatially distinct, and although they share some similarities, they are driven by their local ecosystems. Place-based differences in the food systems play out due to differences in species availability and access to the land driven by the local environmental factors. For Délı̨nę, the relationship to Great Bear Lake defines the local food system, whereas in Kakisa it is the combinations of lakes, rivers and lands between where the community is currently located and Tathlina Lake, where the community was previously located before being displaced by fire in the early 1940s. In Délı̨nę, caribou plays an important role in the community's food system, while Kakisa is more reliant on moose. Both communities are supported by fish from the waters that surround them. As communities have a close relationship to the land, and connections to place, variations in cultural capitals also emerge as place-based knowledge and skills are needed in the different environments. To understand the key differences in the food systems of these communities in these dynamic circumstances, we need to examine other capitals, including human, built, financial and political.

Table 8. Table of community capitals as determined through background information and community interviews (Spring et al. 2018, Spring et al. in prep).

Capital	Community	
	Kakisa	Délı̨nę
Social	(+) Strong social economy (food sharing) (+) Small, close-knit community (bonding social capital) (+) Experience with research networks outside of community (bridging social capital) (-) Some issues with degradation of bonding social capital in the community. (-) People leave community for education and jobs	(+) Strong social economy (e.g., food sharing) (+) Close knit community (+) Experience with networks outside of community (-) Social change due to global pressures
Cultural	(+) Most community members maintain traditional practices and activities, and a strong connection to the land (-) Limited time available to take part in traditional activities (for some) (-) Language as barrier to transfer of Traditional Knowledge (-) Some youth not as engaged in traditional foods and activities	(+) Reliance on traditional foods (+) Maintaining traditional practices and activities (+) Many are fluent in their traditional language (-) Language as barrier to transfer of Traditional Knowledge (-) Some youth not as engaged in traditional foods and activities (-) Changes to relationship with land
Natural	(+) Abundant sources of country food (+) Abundant access to clean water (-) Concerns of impacts of development on the health of the land	(+) Abundant sources of country food (fish, moose and others) (+) Great Bear Lake (-) Declining caribou herds
Financial	(+) Access to community funding and government grants (+) Small commercial fishery (-) Limited availability of jobs in community (-) High cost of living (food, gas and supplies)	(+) Access to community funding and government grants (+) Comprehensive land claim (-) Limited availability of jobs in community (-) High cost of living (food, gas and supplies)
Political	(+) Active local government (+) Pending protected area designation (-) Limited decision-making ability in terms of control of lands	(+) Multiple layers of government (+) Comprehensive Land Claim (+) Self-Government (+) Co-management of resources

		(+) UNESCO Biosphere Reserve Designation
Human	(+) Engaged community (active in training opportunities) (-) Small population (-) Time and effort needed to travel to other communities for store-bought goods.	(+) Engaged community (+) Educational opportunities in community (+) Employ consultants to fill capacity voids (-) Depend on outside expertise for some services
Built	(+) All-weather road access (+) Local school (+) Community hall and culture camp (-) Limited infrastructure (health, water, etc.) (-) No store	(+) Community services (water, wastewater and health) (+) Access to 2 stores (-) Fly-in community (winter road access only)

The first and most obvious difference between these communities is their population. Kakisa, with a population of 50, is the smallest community in the NWT. This small population, where many community members are linked through kin relationships, may contribute to high levels of bonding social capital within the community, but are limiting the community in other ways. First, the community is involved in many meetings in the region, not only to develop a protected area for their traditional lands, but also to support the regional comprehensive land claim agreement being developed and in support of other initiatives that may help protect the land. However, there are few community members who attend these meetings on behalf of the community or Band Council. Attending regional meetings, reporting back to the community, and trying to keep the community engaged puts a strain on these individuals. As reported elsewhere, meeting fatigue can become an issue in Northern communities (Brook et al. 2009, Bali and Kofinas 2014). During one interview, the point was made that having too many meetings was straining some of the social connections qmoung community members.

> "So right now if we were to hold stuff, it's hard to get people to come...They don't want to be a part of it, they just can't be bothered. Too many meetings. And what do they get out of it? Why so many meetings? Why this? Why that? They just want to be left alone. That's how it is right now."
>
> ~Elder, Kakisa

As the community is trying to be involved in regional discussions and building political capital to protect their natural capital, some people are having to be away from the community and involved in many meetings, while others are becoming disenfranchised from the process all together. The interplay points to the lack of human capital as constraining political, natural and social capitals.

Second, and maybe most crucial to the community's food system, is that with a small population, there are few Elders remaining in the community. With only a few sources of Traditional Knowledge, passing on that knowledge becomes more difficult. The well-being of the Elders is a concern for the community. As their health has deteriorated and their mobility has suffered, it is harder for some Elders to be on the land.

> "The Elders are... some of them are really old now, they are 80 and 90, too old to go out. Some of them don't want to go out anymore, they just want to stay home and be warm in their warm houses."

~Elder, Kakisa

Because there are no health services to take care of the Elders in Kakisa, they may, at some time, need to relocate to a neighbouring community for care, effectively removing an important resource from the community. The fact that the community is so small may be limiting opportunities for cultural capital and Traditional Knowledge to be passed to the next generation, and therefore limit the communities ability to access traditional foods (Power 2008, Ford et al. 2013b).

Délı̨nę represents a larger and more complex community, with more families, local governance, organizations and infrastructure. It may offer an example of a scaled-up food system compared to Kakisa. Délı̨nę's human capital is bolstered by the presence of organizations that operate in the community, including both regional and community entities, the Ɂehdzo Got'ı̨nę Gots'ę́ Nákedı (Sahtu Renewable Resources Board – SRRB) and Délı̨nę Ɂehdzo Got'ı̨nę (Renewable Resources Council) respectively, both of which were key partners in this research. These organizations have strong links to the community, are effective at engaging and building consensus (and social capital) amongst community members, and advocate on behalf of the community with respect to land and resource issues. These organizations create social and political space to engage and inform decision making to protect natural capital. They have also acted as the link between researchers and the community, and are therefore critical to bridging social capital, which can add to human capital through training and capacity building opportunities and can help to spiral up other capitals in the community (Emery and Flora 2006).

As a larger community, Délı̨nę also draws from a larger pool of community members, and expertise, with many more knowledge holders when compared to Kakisa. However, some of the same issues remain, specifically the transfer of knowledge between Elders and youth (Spring et al. 2018, Spring et al. in prep). Language is considered a major barrier to the transfer of knowledge but, for some, the expectation of compensation for time spent mentoring youth may be contributing to the issue. As described by a community member during interviews:

> "I really like to teach our younger generation. To me, what can I explain to the kids is what I went through myself. Many times some older people than me, when asked him to go take some training, teaching kids how to live off the land…they expect to get paid, and I disagree with that myself. If I want to do that I do it, I volunteer. Because that's how I was taught by my dad and my grandfather and other people that taught me how to live off the land. To me how I look at it is if we continue to do that and getting paid, we will lose our traditional way of life."
>
> ~Community Elder, Délı̨nę

Although several community members did indicate that they would mentor youth without being paid, this comment may reflect on some of the other capitals that also need to be addressed in the community. One potential barrier may be the limited financial capital available to some community members, or the added expenses and time commitments needed to mentor youth on the land or share equipment, as noted in other communities (Ford et al. 2008). An impact of financial capital on the food system is often seen through the high cost of food in the North, but limited opportunities for jobs and high cost of living puts pressure on communities and are other

barriers to food security (Ford et al. 2006a, Ford 2012, Skinner et al. 2013). However, if financial capital is limiting cultural capital, which is vital to climate change adaptation (Pearce et al. 2015) and a community's food system (Spring et al. 2018), it can only be addressed through programming and policy at multiple scales.

Size of the community also drives key differences in the built capital accessible to the community as does the geographical location. Kakisa contains very little infrastructure to support the community. Community members therefore depend on services from elsewhere to help support their livelihoods. Due to the community's proximity to the all-weather highway, Kakisa has access to services in other communities, accessing this external capital to support their livelihoods and food system. For example, water is trucked in from a community 100 km away, and health services and stores can only be found in neighboring communities. Community members allocate their time and financial capital accessing these services from locations around the region. The all-season road that connects the community to centres in the territory thus becomes the lifeline for the community that is vital to their food system. It also means that the food system operates at a regional level. Community members depend on accessing built capital of other communities to support their food system, through employment, stores etc., and conversely, other communities depend on Kakisa to support their food systems. As one participant mentioned:

> "Usually we are pretty good with getting Elders in [Fort] Providence moose meat and stuff."
>
> ~Chief Lloyd Chicot, Kakisa

Community members share food with those in surrounding communities, ensuring access to traditional foods for those who may not have the means to procure it. The social economy of food sharing, therefore, extends outside the boundaries of the community and, with it, the food system. The commercial fishery in Kakisa also supports restaurants and food systems as far away as Yellowknife. As the basis of the community food system is in harvesting foods from their lands, the networks that the community is involved in stretch out to other communities throughout the region. As a result, the space that the Kakisa's food system occupies goes beyond the traditional lands of the community, and instead is fostered by the physical connections between communities in the region. These networks operate as a type of food hub for both the selling and sharing of food throughout the region (Blay-Palmer et al. 2013b) and support both the formal and informal economies. This could represent a hybrid food system, that takes elements of both the wage-based and traditional food systems into one that is optimal for the community (Jarosz 2000), and has been referred to as "best of both worlds" (Harnum et al. 2014). However, the selling of traditional foods, in this case fish, is a contentious issue as it is not permitted in many regions based on either treaty or comprehensive land claim and can be perceived as being against cultural practices of sharing (Burke 2005, Chan et al. 2006, Damman et al. 2008, Gombay 2009). There are obvious benefits through the building of financial capital by supplementing income to support and encourage community members to participate in the traditional economy which could, in turn, boost cultural capital in communities. This could offer a solution to some of the financial capital constraints limiting mentorship in Délı̨nę as discussed earlier. Selling of country foods is part of a larger discussion happening across the North in terms of supporting food security of communities (Ford and Beaumier 2011). Kakisa is an example of

how selling fish works on a very small scale but has large benefits to the community and to surrounding food systems, and could be a good practice for communities in the NWT.

Délı̨nę, on the other hand, contains a great deal of infrastructure, including water, wastewater and health services, stores and tourism infrastructure. The community is well supported, because it has to be, as it lacks an all-season road and is therefore geographically isolated from other communities. Although the community is serviced by an airport, where fresh foods are delivered regularly and has regular passenger flights, and the Bear River, which flows from Great Bear Lake to the Mackenzie River, can be used as transportation link to the neighbouring community of Tulit'a, Délı̨nę is isolated most of the year. The only option to transport food, fuel and most other supplies to the community is via the winter road, which typically operates from January to March. And that link is threatened by the impacts of climate change (Prowse et al. 2009). In fact, a fuel truck fell through the ice on Great Bear Lake one week after the results workshop was held in the community in February 2016, a time when the road was typically frozen (CBC News 2016). The winter road also provides community members with the opportunity to travel south to major cities (Yellowknife or Edmonton) to purchase larger items or stock up on less expensive goods. So, the community's food system, when not being supplied by traditional foods, is subject to periods of increased regional activity during winter road access, followed by long periods of local isolation, dependent upon air transport of fresh foods and resupplies. This isolation of the community, and therefore its food system, can have both positive and negative feedbacks on capitals. For example, if equipment or supplies are needed or in need of repairs, and cannot be fixed locally, long waits for replacements may be required, meaning that equipment cannot be used on the land to access food. One youth commented during the results

workshop that he may not be able to participate in the planned on-the-land experience due to the repairs needed for his skidoo, and if the parts did not arrive in time, or he was unable to borrow someone else's sled, he would miss the opportunity. Furthermore, it was discussed that as engines become more advanced, they rely on more specialized equipment for maintenance and repair. This equipment and expertise may not be available in the community. Being isolated and remote may also be a positive influence on the community. It may be a factor in the high social and cultural capital found in the community and their reliance on the traditional economy to support their livelihoods (Harnum et al. 2014, Simmons et al. 2015). The traditional economy may therefore be accessed to support the food system out of necessity, as there are few alternatives for some, as well as the desire to practice the Dene Way of Life.

Opinions in Délı̨nę around the potential development of an all-season road, linking the community to the road network in the south, is mixed. As described by one participant:

> "Elders said don't make the highway to Bear Lake. That's what the Elders were saying. But after the Elders are gone and the young ones take over, they like the highway and bring the highway in. They can have big problems."
>
> ~Charlie Neyelle, Délı̨nę

The big problems being referred to typically involve development and degradation of the environment that comes with it, but also concerns about crime, drugs and alcohol. Kakisa also has some concerns with the recent opening of the permanent bridge built across the Mackenzie River as it has allowed for much easier access to the community and they feel they need to be

more vigilant about safety and security. The presence or absence of an all-season link to a community has played a role in shaping the food systems of these two communities. It has enabled Kakisa's food system to act on a regional level, more as a network, compared to Dél̨nę, which functions more in isolation.

The final capital highlighted as a key difference in this comparison is political capital. Kakisa and Dél̨nę have different political capital available to them and this impacts their food systems in different ways. Dél̨nę is part of the Sahtu Metis and Dene Comprehensive Land Claim Agreement that was signed in 1993. Not only does the land claim give substance rights as well as increased say in land management decisions, but it also created organizations to uphold and advocate for those rights. Organizations such as the SRRB and DRRC, and now recently the Dél̨nę Got'ı̨nę Government, therefore, operate, in part, as civil society organizations (CSOs). CSOs are vital to sustainable food movement in other regions as they advocate on food issues on behalf of communities (Blay-Palmer 2016). They act as a liaisons on behalf of the community in environmental management decision-making with the Government of the NWT, therefore working to protect vital food resources. They also work to facilitate community involvement in research and other decision-making meetings, building social and political capitals. Through the land claim, this community has created the political space needed to enhance participation in decision-making. They use this space to build other programs and initiatives that continue to build more political and social capital for the community. Through the land claim, UNESCO designation and self-government, that investment is now paying off. This political space is leading to the spiraling up of capitals, where the development of one capital leads to increases in other capitals (Emery and Flora 2006). Therefore, the community has a great deal more

responsibility for decision making on community matters, from infrastructure to education and programming through self-government. This may enable the community to address other capitals and aspects of the food system to promote sustainability, self-sufficiency and food sovereignty.

Kakisa, by comparison, spends a great deal of their human capital traveling to meetings to be involved in the regional discussions related to the regional land claim agreement. But ultimately, the Band is responsible for advocating on behalf of the community. The community has, therefore, created the political space, but does not have the same tools and actors to occupy this space. The community works closely with organizations, communities and government in the region but often lacks the CSO that acts on behalf of their community. The community is also actively pursuing Protected Area Status for some of their traditional lands.

> "We are looking into the protected area...We need to look at conserving areas that are really rich like Tathlina. So we can ensure that our way of life continues and there will be areas for people to continue what they are doing where there won't be any development."
> ~Ruby Simba, Kakisa

The Protected Area Status is a tool that the community is attempting to utilize in the absence of the land claim, which will give them some level of co-management over their lands. But with oil and gas development bordering their southern boundary and forest management strategies that have enabled a wood pellet industry to emerge in the area, the need for the community to be a part of these initiatives is a struggle at times for such a small community. Having some form of

protection for their lands, as well as some of the institutions that come with land claims to advocate on behalf of the community, would likely ease some of the pressures the community is facing.

In the NWT, decision-making for much of the renewable resources is typically done through co-management and is largely facilitated through comprehensive land claim agreements (Berkes et al. 2007, Armitage et al. 2011a). Co-management emphasizes co-learning and adaptive management of resources and socio-ecological systems among partners, which typically include communities and government participants (Plummer and Armitage 2006). However this has never been a comfortable marriage (Bayha 2012). There are examples of Traditional Knowledge enhancing the management of renewable resources, putting more emphasis on local observations and qualitative measurements and observations by community members (Parlee et al. 2005, Berkes et al. 2007, Polfus et al. 2014). It appears that there is an expectation of Traditional Knowledge to validate scientific research, and not on how the two forms of knowledge can complement each other. Looking to other food movements, such as agroecology, where traditional farming knowledge is used to build more climate change resilient food systems (Altieri et al. 2015) may provide new insights for management in the North. In agroecology there has been emphasis on science both learning from and supporting the traditional and ecological practices of farmers (Altieri 2002, 2004, Altieri and Toledo 2011). Agroecology is a working example of two ways of knowing coming together, much like co-management was envisioned to do, but does so through a food systems lens. Community members see the need for both science and Traditional Knowledge to address community concerns, and a theme of knowledge sharing and working together with the researchers was discussed during interviews:

> "Non-Dene researchers and scientists, we need to work together and help each other learn about the land, learn about the animals. We know for a fact that right now the caribou is in decline. And we have to deal with we have to work with. Not only that, but we know for a fact that the water level is also low. So those kind of things we need people, scientists that are knowledgeable about that to come and work with us, and share information with us."
>
> ~Elder, Délı̨nę

Both communities are aware of the changing landscape and look to work with scientists to share knowledge to help them understand and adapt to the changes. Communities in the Sahtú have established procedures and guidelines for research in the region to ensure community engagement and involvement in research. This helps to ensure community needs are incorporated into research, but also that results and outcomes can be shared with the community. They have successfully created a political space that serves to align research with community priorities, and serves to facilitate the transfer of knowledge to decision makers. Again, it is the political capital in the community that builds capacity and spirals up other capitals.

Political capital, and local decision-making over resources, appears to be a key element of food sovereignty. If we look to the food sovereignty movement, *La Via Campesina*, we see the assertion of peasant rights to land and self-determination for subsistence agriculture and food systems (Nyéléni 2007, Patel 2009). While rights are being extended to some peasant land owners, we do not see the same privileges being granted to hunter-gatherer food systems. These

hunter-gatherer food systems rely on ecosystem health on a large scale. And complexities arise when the ecosystems, as well as migratory routes for food sources, cross geopolitical and jurisdictional boundaries and where the obligation of the state to protect wildlife conflicts at times with the livelihoods of communities. If the food system is ultimately determined by the health of the ecosystem, managing that ecosystem becomes instrumental in the sustainability and long-term viability of the communities that the system supports. Furthermore, Délįnę is but one community that relies on some of these shared resources. Therefore, the ultimate success of conservation of natural capital, such as the long-term health of the caribou herd, may lie in the regional approach, with other jurisdictions supporting similar initiatives to limit their impacts on the herds, as well as studies to help understand ecosystem impacts under a changing climate regime. It appears that the community level is insufficient when dealing with certain capitals of the community's food system. The complex mix of scale, livelihoods and natural capital play a keys role in the food system (Dahlberg 1993).

5.4 Conclusion

This research compares the food systems of two Indigenous communities in Canada's North using the CCF. The food systems in both communities are subject to the sometimes shared and sometimes unique circumstances, geography and available capitals of each community. For Délįnę and Kakisa, issues of place, space and scale drive differences in human, built and political capitals that shape the food systems. The presence of political capital due to the comprehensive land claim and the institutions that come with it has enabled Délįnę to have greater control of their own food system. Through co-management, and community engagement, Délįnę has created the space that has allowed the community to build procedures and programs aimed at

contributing to the decision-making required to protect their natural resources. This has allowed the community to focus on building more political capital, through self-government and a UNESCO Biosphere Reserve designation, to continue to protect natural capital and support their food system. Political capital is having a spiraling up effect on other capitals. Kakisa, as the smallest community in the NWT, lacks this political capital and so allocates other capitals to participate in many different discussions on a regional level to protect their lands. Rights to land and resources, such as wildlife, are key concerns among communities and are essential in food security in the north. Built capital, or infrastructure, also plays an important role in shaping the food system. A road network allows Kakisa to access capitals throughout the region to compensate for those which the community lacks due to its small size, but also enables them to contribute to the food systems of neighbouring communities. Lack of an all-season road connecting Délı̨nę to other communities may be limiting the food system in many ways, but geographical isolation, as well as essential services, may also be a contributing factor in the community's push for self-sufficiency and food sovereignty. This research highlights the complex nature of food systems and illustrates taht one capital should not be prioritized over another in terms of building a more sustainable food system; all capitals have a role to play and influence other capitals of the food system, but those roles are specific to place and are continually changing. However, protection of natural capital, through the decision-making abilities of political capital, is an important aspect of food security in these northern food systems (FAO 2012).

Livelihoods frameworks can often be limited by issues of scale (Scoones 2009), and scale plays a key role in the availably of certain capitals. Kakisa's food system depends upon capitals present

in other communities due its small size and lack of infrastructure. Furthermore, the social economy of sharing traditional foods links the community to the surrounding region. The food system operates regionally, meaning some capitals are shared between surrounding communities. In Délı̨nę, which is geographically more remote and isolated from other communities, the food system operates more locally. However, scale impacts the effectiveness of political capital, and how the community determines their food system. Caribou, for example, is an important cultural resource to the community, but management of the species involves multiple communities, regions, and forms of government. For both communities, protection of natural capital relies on working at a regional level with regional partners and all levels of government to protect food resources now and into the future. The CCF, in the context of a systems approach, overcomes some limitations of other livelihoods frameworks by identifying how local issues impacting the food system can be influenced by regional, territorial and national policies, decision making and infrastructure. Furthermore, this framework offers insight into how community strengths, as well as gaps, can help address these issues or barriers to food security at these multiple scales. It is also apparent that both communities have a great deal to learn from each other. Building synergies between communities on issues surrounding governance, stewardship and food security would help community-led initiatives scale up and out. Creating this regional space for these synergies to happen, and therefore developing social and political capitals for communities regionally, may be a way of addressing food insecurity issues in the North.

6 Conclusion

6.1 Introduction

As communities around the world deal with the impacts of climate change on food resources and livelihoods, providing case studies and promoting the transfer of knowledge to other communities is important to adaptation and resilience for local food systems. The work presented in this dissertation outlines two case studies that examined the vulnerability of the food system, and community health and well-being due to the impacts of climate change, but also in the broader context of ongoing systems-change in the region. This research provides new insights into the broader discussion of food security and climate change and offers examples of participatory methods, a framework, and community-driven solutions to address these issues. In the context of Canada's North, where climate change is having rapid impacts on the land and ecosystems that support community food systems, sharing this knowledge is urgent. As this research demonstrates, communities can play a vital role in building a more resilient food system that ensures food security for future generations. The research also highlights the potential of a participatory methodology linked to a systems-based framework as a pathway for change. This research enabled communities to identify key questions pertaining to food security and climate change, and supported them in adaptation planning to build stronger, more sustainable food systems. This chapter summarizes key findings of the research presented in Chapters 3 – 5, and places these findings into the context outlined in the introductory Chapters 1 – 2. It will begin by revisiting research objectives, and summarize key findings that speak to each objective. A discussion will then be put forward for possible future research directions on food systems in the North. This chapter concludes with some closing thoughts and lessons learned throughout the course of this research.

6.2 Revisiting Research Objectives

Objective 1: To better define and understand the complex northern food system using the Community Capitals Framework (CCF).

Many communities across Canada's North are dealing with issues of food insecurity that are affecting their health and well-being. Although the public perception often highlights the high costs of food and unavailability of healthy food options as the driving factors, there are ongoing social, economic and political issues that have shaped Indigenous communities and their food systems for generations (Power 2008, Loring and Gerlach 2009, Council of Canadian Academies 2014). For communities, the food system is complex and often a combination of the traditional social and wage-based economies (Abele 2009, Harnum et al. 2014). The complexity of this northern food system is not captured or represented as part of food systems dialog, that are typically agriculturally based. The primary purpose behind this thesis was to propose a systems-based approach to describing the unique food system in northern Indigenous communities. By applying the Community Capitals Framework (CCF) through a lens of system-of-systems (SoS) approach, this research captures many of the complex food system interactions. Building from a Sustainable Livelihoods (SL) approach, which accounts for the multiple ways that communities make a living, is useful in this context because it allows for the incorporation of Traditional Economic activities of hunting and gathering, the social economy of food sharing and community togetherness, the wage-based economy, and the tensions that exist amoungst the three. This systems-based approach also helps to describe this unique system in the context of other sustainable food system literature (Hipel et al. 2010, Stroink and Nelson 2013, Blay-Palmer et al. 2015) and highlights the uniqueness of food systems in the North, but also the

commonalities it shares with other food systems. This research shows that cultural, social and natural capitals play a key role in community health and well-being, but are under threat due to global environmental and social changes, and how other capitals, including human, built, financial and political, are also critical in shaping food systems, both individually and through interactions with other capitals, and are subject to issues of place and scale. This CCF approach does offer a unique contribution to the literature because it defines the systems that influence the community's food system; more importantly, it does this from a participatory and inclusive methodology that incorporates place, values and ethics (Flora et al. 2004, Hipel et al. 2010). This also confirms that every community food system is unique and driven by local circumstances and availability of capitals (Marsden 2012). Though the use of capitals, this research illustrated how communities can deal with issues of scale by building social (both bridging and bonding), political and financial capitals to participate in regional decision-making concerning elements of their food system in spiraling up other capitals (Emery and Flora 2006, Mount 2012, Blay-Palmer et al. 2015).

Objective 2: To conduct case studies in Indigenous communities in the NWT identifying vulnerabilities of the food system to the impacts of climate change with a focus on harvesting practices and country food security, now and in the future.

First, this research reinforced the fact that the health of the land, water and animals, as well as being on the land and the consumption of traditional foods form the basis for a definition of health and well-being in NWT Indigenous communities (Parlee et al. 2007). As the effects of climate change impact the land, they have direct impacts on communities in the NWT. Through a participatory framework, including semi-structured interviews, community members shared

their experiences regarding changes they have experienced on the land, and how these changes impact their health. For both Kakisa and Délı̨nę, there were some shared concerns, including declining water levels, increased water temperatures, sudden changes in weather, and some place-based concerns. In Kakisa, there was concern regarding the availability of moose, while the community concerns in Délı̨nę revolved around long-term health of the caribou herds. Of most concern to both communities were the increased risk to harvesters associated with changes on the land, the concern that Traditional Knowledge was not being passed down to younger harvesters. Many of these impacts have been captured in studies conducted throughout the North (Ford et al. 2006b, Pearce et al. 2009b, Andrachuk and Smit 2012, Wesche et al. 2016). But the vulnerability of the food system is compounded by issues of global change that have compromised social and cultural bonds within the communities. The CCF visualizes the food system within the contexts of greater societal changes and challenges facing communities. This aligns the current research with other researchers who investigate climate change as but one contributing factor to issues negatively impacting community food security, health and well-being (Loring and Gerlach 2009, Gerlach and Loring 2013, Wesche et al. 2016). This offers a more comprehensive way of looking at issues of climate change in concert with other pressures, such as development, rights and conservation, from a community perspective (Moran et al. 2007, Nkem et al. 2013, Nikolakis and Grafton 2015, Connolly-Boutin and Smit 2016). Of most concern to communities is the weakening of social and cultural capitals over time that further contribute to the vulnerability of the food systems, as traditional skills and language are not being passed on the next generation of harvester. This compromises the community's long-term ability to harvest traditional foods. For both communities, strengthening social and cultural bonds were priorities for addressing vulnerabilities and building a more sustainable food system.

Objective 3: To identify community-based programs and initiatives to adapt and build resilience into the food system for future generations.

The PAR approach taken in this research allowed for community members to identify initiatives to foster a more sustainable food system. In both communities, growing food was seen as a way to increase self-sufficiency and provide better access to healthy, affordable food. However, it was noted that growing food was a skill that did not exist in the community, and was not a part of the cultural heritage of the communities (Wesche and Chan 2010, Douglas et al. 2014). Therefore, in order to grow food, new capital needed to be created, not only to teach the skills but support the communities along the way. Taking care of the land and waters was also a common theme. Both communities were interested in helping to monitor the health of ecosystems and were interested in working with researchers and scientists to help monitor these resources. Acting as stewards of the land was important to communities, and empowering community members to monitor and protect the lands is another key factor in promoting food security for the future. Community-based monitoring strategies, in collaboration with natural and physical sciences, can help better understand changes on the landscape and aid in community adaptation (Bennett and Lantz 2014, Gill et al. 2014a). More specifically, this can also highlight the desire on the community level for future development of the Indigenous Guardians framework being proposed by many Indigenous groups across the country (Trant et al. 2012). Perhaps most important to securing food for future generations is the sharing of Traditional Knowledge and language within the community. On-the-land experiences for community members, particularity those that foster linkages between youth and elders, were seen as critical. On-the-Land experiences were ideal settings for communities to come together, learn skills and

share knowledge. Both communities prioritized this kind of project to be integrated into future research endeavours to promote food security, given that cultural capital emerged as one of the defining capitals in the community food system. Building policies and programming to ensure long-term support for communities is essential. This research contributes to an important discussion on possible territorial and national food policies by ensuring that the voices from the community are heard in order to achieve a just and sustainable food system.

Objective 4: To identify adaptation strategies currently employed or as possibilities for future application by community members to mitigate adverse impacts to traditional harvesting practices and community health and well-being in the context of climate change.

Using the CCF, capitals were identified that are being used by communities to cope with climate change. For example, due to increased water temperatures, harvesters are having to check nets more frequently. Also, due to changes in landscape and water resources, travel routes onto the land can be unreliable or unsafe. Coping strategies involve traveling around areas of concern which adds to the cost of travel on the land in terms of gas, supplies, and often an individual's time. There is a clear need to develop more social and cultural capital to ensure Traditional Knowledge and skills are passed throughout the community to ensure that people are prepared and safe on the land. Essentially more human and financial capital are being expended to access the same amount of food resources. Other issues that communities are facing now revolve around how some preferred food sources are not as plentiful as before. Both communities are seeking greater involvement in the protection of these species, with Délı̨nę's caribou management plan and Kakisa's protected area strategy, building or utilizing political capital to protect these important resources. The replenishment of these capitals is critical to ensure that

communities continue to adapt to the changes on the land.

This research contributes to an emerging dialog on food sovereignty in the North in many ways. The participatory framework allowed for communities to envision a more sustainable food system that provides access to nutritious and culturally appropriate foods, which are the building blocks of community food security (Hamm and Bellows 2003) and food sovereignty (Patel 2009). The initiatives and concerns that help or hinder the community from realizing their vision have direct research and policy implications and identify where resources are needed most. Most importantly, as natural capital emerged as a critical part of the food system dialog, rights to, and protection of, land, water and natural resources were identified as an important tool to ensuring food security for the future. As this research illustrated, political capital can be used to spiral up other capitals to aid in food systems transformation, producing a multiplier effect. And furthermore, communities that do not have such capital allocate other available capitals (human and financial) to achieving the goal of protecting the land.

In dialog on food sovereignty, land rights are a fundamental part of the right to food (Patel 2009, De Schutter 2012, Grey and Patel 2014), but are difficult to uphold. Enabling and empowering communities to have a leadership role in determining their food system through their access to land moves us away from short-term food security solutions to issues of food sovereignty, governance and rights (IPES 2016).

Objective 5: To offer practical examples of how Participatory Action Research (PAR) can empower communities to adapt to the impacts of climate change and build more sustainable food systems.

Participatory Action Research (PAR) is still an evolving process in the North. This research offers two examples that add to a growing literature and approach in both food systems and northern research. It is hoped that these two examples can be seen as "good practices" for how research can be conducted by and for communities in the North and can contribute to the literature to assist other researchers contemplating work in the region (see Caine et al. 2007, McGregor et al. 2010, Tondu et al. 2014). What evolved as part of this research was two very different experiences in participatory research, as participatory methods, like food systems, are place-based. Even though the research was built upon principles of community engagement and trust building, it was local circumstances that ultimately altered the approaches taken. Although both Kakisa and Délı̨nę have a great deal of experience with research, these past experiences have informed how each community wants to be involved as part of the research process. In Délı̨nę in particular, through the spiralling up of their political capital, they have created guidelines and expectations concerning how research would be conducted in the community. It is a tremendous achievement, one that puts the need to engage and consult the community as the foundation for any work done in the community. While PAR is built on these principles, issues arose when the formal research space created by the community impacted the informal space where interactions and trust building could occur. As well, although not the fault of the community nor the researcher, weather, travel costs and logistics will always be a barrier to creating these informal linkages and building trust. Simply put, PAR in Délı̨nę may occur over a longer-term, so long as research can be funded continually, and quality time and interactions

with community members can be fostered.

The PAR experience that emerged in Kakisa was driven by two main factors: the presence of a community research coordinator, and the partnership with other organizations. The research flowed through the community research coordinator, who was committed to seeing positive change happen in the community. Using their social capital enabled strong connections to the community to be established and allowed for the research to continue throughout the year instead of being limited to site visits. Although a similar position emerged, for a time, in Délı̨nę, it was not sustainable due to personal circumstances. The loss of this individual slowed progress significantly and set back much of the future plans for immediate follow-up of community-identified projects. Through other organizations, the projects identified by the community were funded and implemented through a community-organization-academic partnership. This example of developing bridging social capital, and establishing a support network for the community, proved beneficial in further developing PAR. The benefits of the research were illustrated through the implementation of these community-defined projects, which built stronger ties and trust. Although the research still may not be full PAR, we have shown how we have been able to build towards that goal.

What was novel about the research was the action associated with PAR. Both communities spoke of the constant meetings, with little action to show for it. In Kakisa, funding has been obtained to implement initiatives such as growing gardens, recycling and community-based monitoring programs. Collaborations have begun with the community's school to work directly with the youth on projects aimed at teaching both science and traditional skills, including on-the-land

camps and other field activities. In Délı̨nę, although progress has not been as rapid as in Kakisa, this research has informed the community's Caribou Management Plan and related activities, as well as youth scholarships for On-the-Land training. The research conducted has directly impacted the communities and has begun to build more sustainable food systems.

6.3 New Directions

This research focused on community-level adaptation and food system transformation in response to pressures of climate change on food systems. The CCF was used to highlight community strengths and identify gaps to help address concerns and implement initiatives to build resilience into the food system. However, the research included as part of this dissertation has been a first step in the food systems work in the NWT. The next steps are to continue to build relationships and connections with communities and to help implement the initiatives they have identified. As a researcher, my role may be to help provide that bridging social capital to continue to develop projects, funding proposals and other opportunities to support the communities where they see fit. These future initiatives include building capacity for growing food and other stewardship projects like mapping, monitoring and recycling, as well as promoting opportunities to train youth on the land to learn traditional skills and languages.

This approach has been successful to date in both communities. In Kakisa, we will continue to support growing gardens, recycling and community-based monitoring programs, as a long-term partnership has emerged. Meeting with Délı̨nę to see how this food systems research addresses the priorities of the new government structure in the community will be needed and will develop over time. But connections to the Biosphere Reserve have developed and will be the focus of future work both in Délı̨nę and through the Canadian Biosphere Reserve Network. To date, the

amount of work that has spun off from the original research has developed into two other Master's projects in Kakisa, and a related project in Yellowknife. As such, I have been the principal investigator on $194,000 in grant funding that has gone to the communities because of this initial thesis work. Progress has been made in a relatively short time, to aid the communities in their vision for a more sustainable food system.

There is much more work to be done, specifically in addressing issues of scale on various capitals of the food system. The CCF was used to identify how regional, territorial and federal scales influenced many capitals, but those issues and influences were not in the scope of this research. To address some of these issues, and determine how some of the capitals of local food systems interact on regional levels, scaling up this food systems research to the communities around Kakisa and Délı̨nę would be beneficial. By determining regional needs to support food systems, the role of regional and territorial government to support and meet those needs will become more apparent and will identify opportunities for cooperation. These regional discussions could help to form the basis of territorial food policy. However, issues including the management of shared food resources, such as moose or caribou, and the health of the land more generally, may not be under the jurisdiction of regional entities. Rights to traditional lands require involvement of federal agencies, and management of waters and migratory animals are transboundary issues needing cooperation with other provinces and territories. The northern food system is unique in that access to the land for traditional foods that rely on the health of the ecosystem is of critical importance. Developing policy to support this food system on a large scale is needed but will be difficult to realize as issues related to climate change mitigation require international solutions.

The need, therefore, exists to broaden the discussion on food security and the policy needed to ensure adequate, affordable and culturally appropriate food for future generations. Many of the pieces needed already exist and many communities, researchers, and organizations are working on issues pertaining to addressing food security, either directly or indirectly. Bringing these actors together to share knowledge and experiences is needed. Connecting the bridges and networks that are important for community food systems can help to scale up political capital and ensure community voices are represented in policy discussions. Including different and diverse set of actors will also be needed. As evidenced by this research, there are broad and complex issues impacting food systems. Conclusions pertaining to the high cost of food and the need for guaranteed income or increased subsidies on food in remote communities are correct, but only one piece of the overall puzzle. Communities cannot become food secure if they lack basic services such as water, and economic opportunities can also degrade ecosystem health and services. This research confirms the need, and points to specific opportunities, for a broader approach to food security in northern communities, but one that centres on their strengths and needs. This is not an easy task but is integral for the sustainability of northern communities.

6.4 Final Thoughts

Through this research, the complexities of the northern food system were identified by examining the interconnected issues facing communities through a livelihoods lens. Although similar to work done elsewhere, specifically related to the impacts of climate change on northern communities (see Pearce et al. 2009a, Cunsolo-Willox et al. 2012, Gerlach and Loring 2013), this research used participatory methods to enable communities to envision and build a more

sustainable food system. Using the CCF, community strengths, barriers, and needs were identified and formed the basis of community action plans to move the research into action. Issues of governance, scale, bonding and bridging social capital and culture play a key role in the food systems of northern communities, as do issues of infrastructure, access to basic services, and financial capital. Understanding how the capitals emerge and interact at the community level to form unique food systems in each community is important, as well as issues that cross boundaries and scales. Identifying community-level issues, finding commonalities and synergies between communities, and creating the space for regional dialog will be important as Canada moves towards a national food policy in the future. Making sure the voices of these unique food systems are heard on both a territorial and national scale is critical to inclusive dialog on food systems on all levels.

Through this research, it was always the intention to highlight the positive actions that communities are taking to adapt and transform their food system to become more resilient to the impacts of climate change. It is hoped that through this work, the initiatives identified will make a positive contribution to communities. Food security in the North is a 'wicked' problem (Roberts 2000) for which there is no easy solution. This research highlights a grassroots approach and empowers communities to act; admittedly, there are many issues that will still need to be overcome. First, is that this research and, more importantly, I as the researcher, acted as a catalyst and moved some initiatives forward. Making these initiatives sustainable for the long term requires time, resources, and support for the community. And although much effort was placed into building a support network for some initiatives, human and financial capital are needed, and can be in short supply. It is hoped that this research, and the networks and

connections that were built will light the spark and the work can continue. Second, this research worked on much of the "low hanging fruit", and identified initiatives that the community could do in the short term and not some of the more complex issues involved in transforming the food system. Not only does a clear policy need to be developed to enhance food security and support the traditional food economy at the territorial and federal levels, but climate change adaptation and mitigation programming needs to be enacted and enforced on all levels. There are bigger, structural issues at play that collectively need to be addressed. However, it should be noted that in the limited timeframe of this research a great deal of work was accomplished, and the seeds of future work were planted. Building resilience and trust in the community takes times and patience. Fostering connections between communities, organizations and governments also take time. Sometimes the most important work that is accomplished is not simply in the conclusions or results of our research, but in the partnerships, capacity, and connections built along the way. It is hoped that this work can be a catalyst, and the connections act as a support system, for communities in the North to move forward with self-determination for their community food system.

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Appendix A – Interview questions

NOTE: Although Délįnę is used in this example, the same questions were asked in Kakisa.

The following questions are intended to stimulate discussion and storytelling about experiences on the land and observations of climate change.

1. **Introductory Questions**

How long have you lived in the community? How would you describe Deline to someone who is new and moving here? How would you describe yourself in relation to the land/how do you use/interact with the land? Have you been involved in a research project before? How can this research project help you and your community?

2. **Health**

What is health? What does it mean to be healthy in Deline?

3. **Climate Change**

Is the climate changing? Have you noticed changes in the weather? Is the landscape changing in a way that could be linked to climate change? What have you seen on the land that may indicate this change?

4. **Concerns and Vulnerabilities**

Are you concerned about these changes impacting your health? How are these impacts on the land affecting you?

Possible Follow-up Questions:

Are you concerned that it is more difficult to be on the land? Is it impacting how you get country foods, how much country food you get, and what species you harvest? Can you comment on differences in the last 5 years? 10 years?

5. Solutions

How have people adapted to these changes on the land? Do you do things differently now because of changes with the land? What do you think should be done by the community to help deal with these concerns?

Possible Follow-up Questions:

What skills are needed to continue to support a health community? How much knowledge is already in the community? What are some of the barriers we need to address? Decrease reliance on grocery store? Fuel prices? Do you want to learn (more) about growing your own food?

Would you be interested in learning more about community monitoring of changes on the land? Where is change happening? How is this change impacting animals, plants as well as how you use and access the land? Can you help create a system for the community that helps you make decisions regarding land use and increase stewardship?

How has your community adapted to change in the past? Do you have any experiences that might help the community deal with these changes?

Is there a history of fire around the Deline? How have fires impacted your ability to be on the land? Have fires changed how you use the land in the past?

Appendix B – Sample Community Plan

Dene béré belarewílé - Ensuring food security for future generations in Délı̨ne

Dene béré belarewílé is a 5-year program that will work towards the following objectives, as detailed below:

Food for the Community – Délı̨nę Food Map and Calendar

To secure food for the community for future generations the knowledge of when and where food sources were traditionally harvested will be important. Interviews and mapping these important locations with Elders, and sharing this map with community members and harvesters will be essential to long-term food security. This work tie in with the Délı̨nę Caribou Management Plan and on the land camps (Priority #6) can also be targeted to these locations at different times of year to help foster knowledge transfer and build experience of young harvesters.

Safe Places - Great Bear Lake Cabin and Safe Harbour Inventory

Ensuring the safety of community members on the land and knowing where to go or stay if they encounter trouble while travelling on the land was identified as a priority by community members. By creating a map of cabins, noting who owns them and what condition they are in, as well as places on the land where shelter from wind and waves will be vital information to community members. This map will be shared with community members and made available in emergency kits to be distributed by the DRRC. By noting if repairs are necessary will also be important if funding becomes available for improvement in the future.

Alternative Harvest Knowledge Transfer

For the Caribou plan to be successful, and for the future of food security in the community, ensuring that community members have the knowledge to properly harvest and respect a variety of animals is critical. Furthermore, community members mentioned muskox, moose and wolves as animals that are becoming more plentiful on the land, and these species will become important part of the food system, and also the traditional economy, of Délı̨nę in the future. Opportunities to bring in harvesters that have experience and knowledge about harvesting these other species and showing these skills to the harvesters of Délı̨nę will be the basis of this program. The majority of this program can take place on the land, but there is the opportunity to utilize the Food Processing trailer, obtained in previous years but not yet used, as a classroom on how to properly butcher the meat. This trailer can then play a role in preserving food for storage, and serve as a way to facilitate food being available to trade with the Grey Goose Lodge and other outlets.

Food from the Land

Through interviews, growing food was identified as a key way forward for Délı̨nę to become more self-sufficient and food secure in the future and decrease their dependence on the expensive store food. Potatoes were a key food source that people wanted to see grown in the community. This initiative would build on success of the existing community garden, but work to grow more capacity, knowledge, and interest in the community around growing food. Community members also expressed interest in learning more, and sharing more knowledge about traditional foods and plants that can be gathered from around the community as this can be an important source of food for the community.

Training Young Harvesters

To ensure food security for the future of Délı̨nę, young harvesters must be provided with the opportunity to learn skills on the land, and under the guidance of community elders and knowledge holders. Délı̨nę Young Harvesters (DYH) Program, has been designed in collaboration with youth in the community to harness not only their skills with technology and social media, but empower and encourage them to become harvesters, trappers, food providers and positive role models in the community.

Learning on the land - Supporting transfer of knowledge through on-the-land camps

Providing community members experience on the land as families or large groups, was seen as the ideal way to learn skills and reestablish bonds with each other and the land. Funding to support on the land trips will be priorities as part of any project proposals moving forward. It is hoped that funding can pay for fuel, supplies, equipment rental, and if possible honouraria for participants. On the land camps can also tie into other objectives mentioned above (Alternative harvesting, Training youth and others)